BROADCAST ENGINEERING

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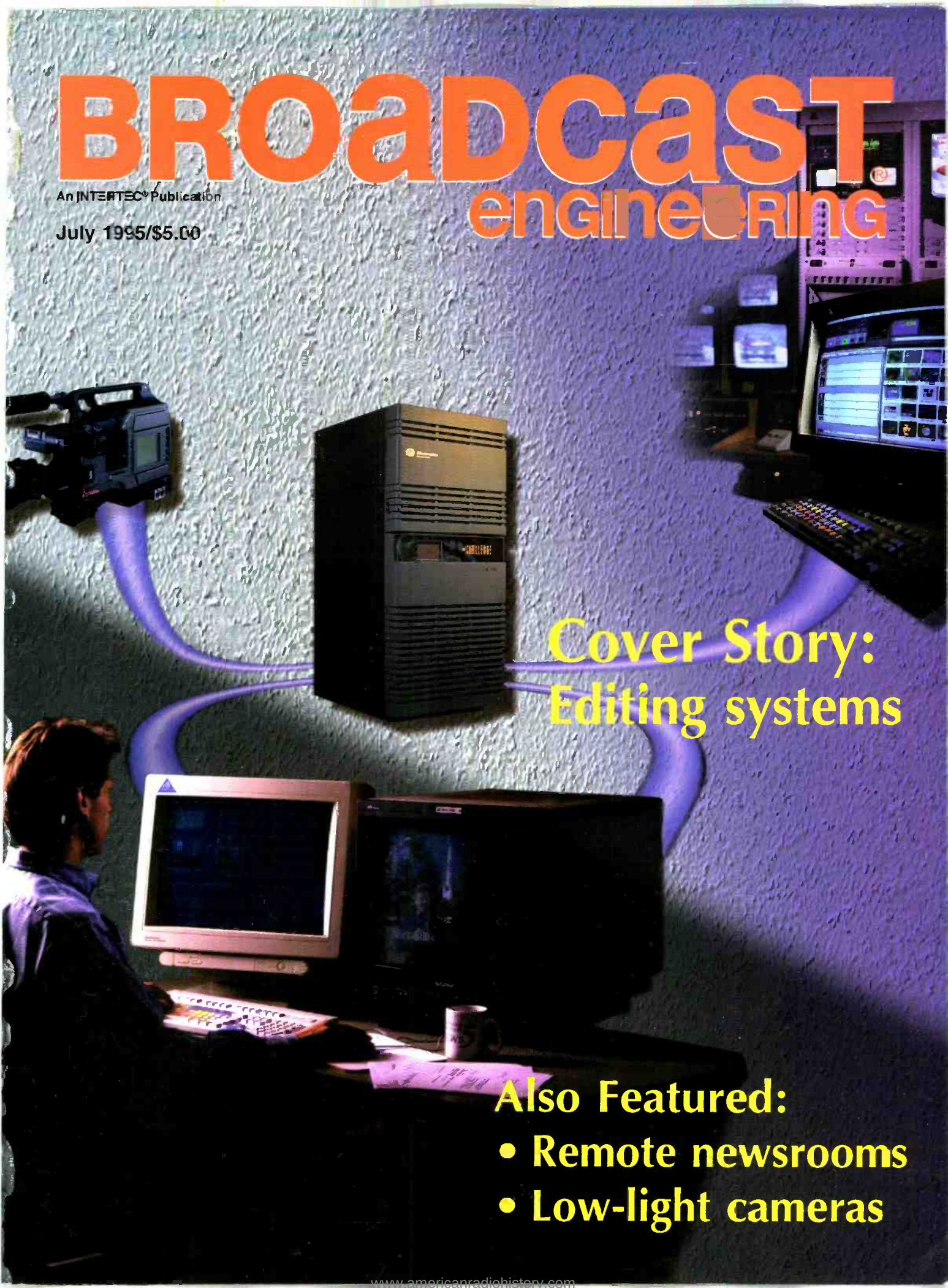

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July 1995 • Volume 37 • Number 8

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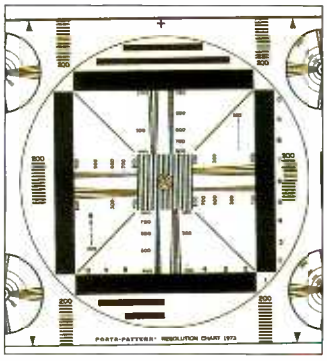

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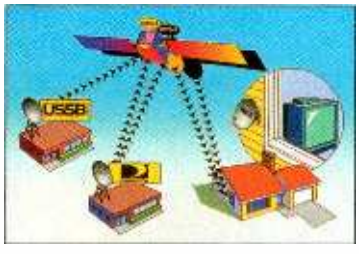
DEPARTMENTS:



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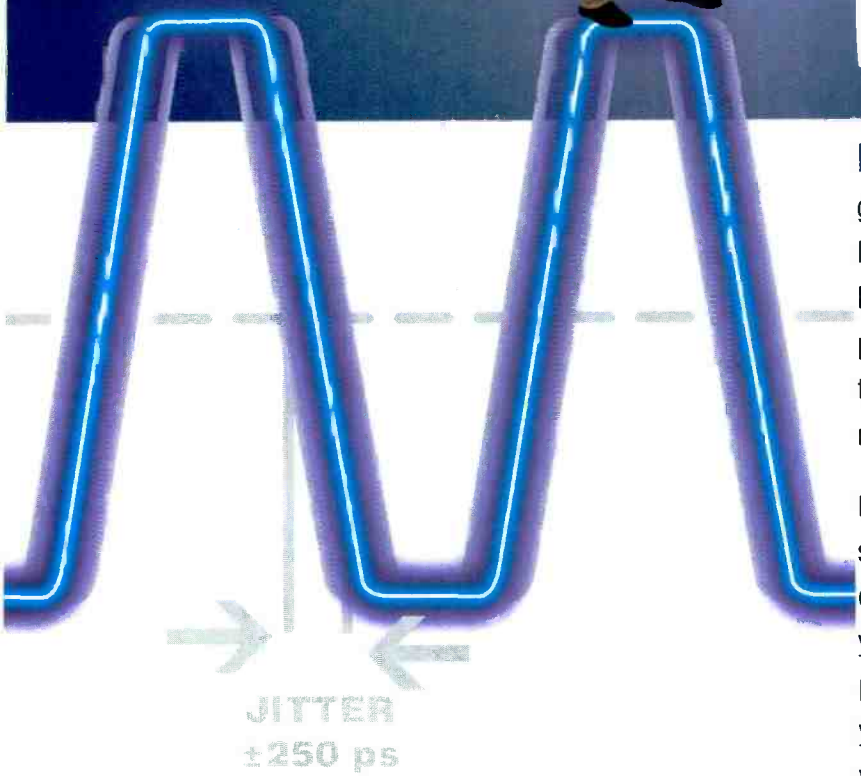
COLUMNS:

ON THE COVER:
Disk-based editing is becoming common practice in many broadcast facilities. Broadcasters are building networked and server-based newsrooms that link acquisition and on-air playback systems into an integrated whole. Cover photo by Avid Technology, Inc.

BROADCAST ENGINEERING (ISSN 0007-1994) is published monthly (except semi-monthly in June and November) and mailed free to qualified persons within the United States and Canada by Intertec Publishing, 9800 Metcalf, Overland Park, KS 66212-2215. Second-class postage paid at Shawnee Mission, KS, and additional mailing offices. POSTMASTER: Send address changes to *Broadcast Engineering*, P.O. Box 12902, Overland Park, KS 66282-2902. CORRESPONDENCE: Editorial and Advertising: 9800 Metcalf, Overland Park, KS 66212-2215. Phone: 913-341-1300; Edit. fax: 913-967-1905. Advert. fax: 913-967-1904.

There Is No Doubt It Will Fail . . .

The Question Is "When" ?



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NEWS

By Dawn Hightower, senior associate editor

Digital video pioneer questions HDTV

In a recent interview with cable TV's *Discovery Channel*, Bill Hendershot of Prime Image, said that a push for digital HDTV is a push in the wrong direction and questioned whether it would ever arrive.

Hendershot is no stranger to digital technology. He led the team that developed the first digital time base corrector in 1973, for which he received an Emmy Award. According to him, HDTV's lack of momentum is attributable to lack of consumer demand and the high price of the technology.

Hendershot is not opposed to digital video in general, or HDTV in particular, his concern is based on economics — the absence of a return on investment for broadcasters and consumers. The cost of HDTV isn't justified by the result. By upgrading image quality under the existing NTSC system, Hendershot says we can attain almost as much improvement for a fraction of the cost.

Cable-Tec Expo breaks all records

The Society of Cable Telecommunications Engineers (SCTE) annual Cable-Tec Expo '95 boasted a total of 6,800 people, including 3,900 registered attendees and 2,900 exhibitor personnel at the Las Vegas Convention Center in Las Vegas, June 14-17. This was the most well-attended and widely acclaimed Expo to date.

This year's attendance represents a 30% increase over the statistics for Cable-Tec '94. More than 325 industry companies displayed products and services.

The Expo officially began with the annual Engineering Conference and consisted of a full day of technical and management papers and panel discussions.

FCC chairman, Reed Hundt, was the keynote speaker for the annual Awards Luncheon. The luncheon also marked the official announcement of the society's name change from the Society of Television Engineers to the Society of Cable Telecommunications Engineers.

Also in conjunction with the Expo, new officers were elected for the coming year. John Vartanian is chairman, Steve Christopher is Eastern vice chairman, Tom Elliot is Western vice chairman, Andy Scott is secretary and Robert Schaeffer is treasurer.

Cable-Tec '96 will be held June 10-13, 1996, in Nashville. The society's next national seminar on "Emerging Technologies" will be held Jan. 8-10, 1996 in San Francisco.

Fritts makes statement on relocation of spectrum

According to Edward O. Fritts, NAB president, the auxiliary spectrum amendment to the telecommunications bill would create tremendous problems for broadcasters and consumers. This spectrum is used for electronic newsgathering and special-event coverage from remote locations and is already seriously overcrowded in many markets. The costs of replacing remote equipment with new products not even on the drawing board and relocating to less desirable spectrum would be a significant burden on broadcasters and other electronic news organizations. It can only result in consumers receiving substantially less live news and special-events coverage.

Digital HDTV previewed at CBS affiliates meeting

On June 2, the 7-member digital HDTV Grand Alliance provided executives from the network's affiliate stations a special preview of its digital high-definition TV system. By the end of this year, it is expected to receive FCC approval as the standard for the next generation of over-the-air TV broadcasting.

This technology is in its final round of laboratory evaluation at the Advanced Television Test Center in Alexandria, VA. It will undergo terrestrial and cable field testing later this summer in Charlotte, NC.

NAB opposes amendment on TV rating system

NAB opposes the amendment to S.652, the telecommunications bill which deals with TV violence.

Under the amendment, TV manufacturers would be forced to put a computer chip into all new televisions. The chip, combined with a required "code" sent by broadcasters on their programs, would allow parents to block the receipt of programs deemed too violent or that contained objectionable content. The FCC, along with an undefined advisory board, would determine what shows would carry what ratings.

NAB believes that no matter how well-intentioned, legislative proposals to restrict violence or access to programs deemed to contain objectionable content means government control of what people see and hear and violates the First Amendment.

According to NAB, broadcasters have made a serious effort to reduce the amount of televised violence over the past two years. The broadcast networks have adopted joint network standards governing violence and for the third year in a row have produced less violent program scehdules. The networks also have adopted on-air advisories and have made advisories available for newspapers and program guides.

NAB's Jobline operates 24 hours a day

Since June 1, the NAB's Employment Clearinghouse Jobline has been available 24 hours a day. The NAB clearinghouse collects résumés for referral to broadcast stations for jobs ranging from entry-level to managerial positions. To assist employment seekers, the Jobline runs recordings of job listings. The position categories of the Jobline change on a daily basis: Monday — on-air talent; Tuesday — sales; Wednesday — production; Thursday — engineering; and Friday and weekends — news.

The Jobline phone number is 202-429-5359. For more information about the NAB Employment Clearinghouse or the Jobline, contact Mike McKinley at 202-429-5497 or E-mail at mmckinley@nab.org.

AES sets date for 99th annual convention

The 99th annual Audio Engineering Society Convention (AES) will be held Oct. 6-9 at New York's Jacob K. Javits Convention Center. Reflecting the impact of interactive technology on the rapidly evolving pro audio industry, this year's theme is "Audio in the Interactive World."

The programs will include a series of workshops on CD-ROMs, the emerging World Wide Web, ISDN and Infrared audio transmission.

For information on participating in the 1995 AES, contact AES headquarters by phone at 212-661-8528 or by fax at 212-682-0477. ■

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EDITORIAL

Broadcasters' golden opportunity

The way some broadcasters are facing the future reminds me of an ostrich with its head in the sand. In other words, they are ignoring reality hoping the drumming sounds of competition and change will go away if they ignore them.

At the 19th Montreux International Television Symposium and Technical Exhibition, a challenge to broadcasters was issued by Ervin S. Duggan, president and chief executive officer of PBS. Providing the keynote address, Duggan reaffirmed his belief in the value of quality television and the future of terrestrial broadcasting in his speech "Broadcasting: Dull Knife or Sharp Blade." Duggan noted three challenges to terrestrial broadcasters:

1. Marketplace competition has increased through the introduction of DBS and cable services.
2. There is a technological challenge not just to re-equip facilities, but to reinvent a mature industry. Duggan noted that while stations grew up programming only one channel, they now face a future where they may have to program several, including HDTV. Unfortunately, said Duggan, some TV stations are getting cold feet toward the reinvention process.
3. Finally, state broadcasters are under increasing political pressure aimed at reducing or eliminating public support for stations.

Let's look at the first two issues. In the early 1950s, radio broadcasters decried a new spectrum-hungry cousin called television. Cries of foul were heard everywhere as some radio broadcasters thought the end of their business was near. Other (more savvy) broadcasters saw television as an opportunity and entered the fray by building stations. Witness the early days where combination AM/FM and TV stations were owned by the same company. When it came to call letters, one set fit all three stations.

Yet, radio didn't die and saw a resurgence in the mid-1960s with stereo FM. While many AM stations hold smaller market shares, FM stations are profitable and increasingly so.

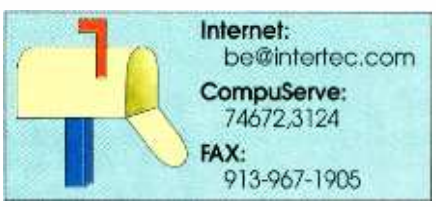
Television was once again labeled as a villain, this time in the late 1950s, as the movie industry saw it as deathly competition. Theater owners and Hollywood moguls believed that movies and entertainment delivered by television would result in the death of their businesses. Yet, broadcast television didn't kill their businesses because Hollywood adapted and grew even larger.

So, if we look to history for lessons for broadcasters, what do we see? According to Duggan, history shows that industries that adapt don't die, but change and grow into even stronger ones. The alternative delivery methods now available (and there will be more) represent a direct head-to-head challenge that must be met. To meet this challenge, look at some of broadcast television's advantages. Broadcast television still commands some two-thirds of the TV audience. Consider that for national advertisers and for program suppliers, broadcast television is still the medium of choice. Both advertisers and program suppliers alike recognize that when it comes to reaching a national audience, they must use broadcast television — because it works.

Broadcasters now have a golden opportunity to reinvent their industry. Those that choose to participate will not only survive, but prosper. Station owners that hold back and long for the old days will find themselves trying to sell the electronic equivalent of black-and-white kinescope images in an era of multichannel broadcasting and HDTV.

Brad Dick

Brad Dick, editor



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By Harry C. Martin and Andrew S. Kersting

TV LMA guidelines

In its Further Notice of Proposed Rulemaking (FNPRM), the FCC proposed guidelines to ensure that TV stations in an LMA comply with the TV multiple ownership rules. The guidelines apply in advance of any rule modifications that may occur in the pending ownership attribution rulemaking.

Specifically, the FCC wants to treat LMAs that involve TV stations the same way it treats those with radio stations. This means that the brokerage of another TV station in the same market for more than 15% of the brokered station's weekly broadcast hours will result in the brokered station being counted toward the brokering licensee's national and local ownership limits. Therefore, if the local TV multiple ownership rules aren't relaxed, TV LMAs would be precluded in markets where the time broker owns or has an attributable interest in another TV station. The guidelines would permit "grandfathering" of TV LMAs entered into prior to the adoption date of the FNPRM, subject to renewability and transferability guidelines.

The Mass Media Bureau also has announced an interim policy regarding LMAs in response to pending applications. These applications propose that TV stations be operated under LMAs by existing broadcasters that are engaged in other relationships with the assignee or transferee. Pending action on the FNPRM, the bureau will not process applications where the broker proposes certain relationships with the assignee or transferee. This will include entering into an LMA *and* providing a loan for some or all of the acquisition price of the station, *or* holding a bona fide option to purchase the station.

In cases where a broker is lending funds to the proposed assignee or transferee, the loan may be secured by the station's assets and a pledge of the licensee's stock, but cannot be dependent on the LMA. A default or termination of the LMA cannot trigger acceleration of repayment of the loan. The broker also may not acquire control of the station through the loan agreement. Where a broker holds an option, the term must be of appropriate duration, and must not involve up-front payments of all or substantially all of the station's value.

Applicants proposing station operations under an LMA with a broker and licensee engaging in one of these relationships should include all documents pertinent to the relationship. These include the LMA, and, where applicable, the loan agreement, the promissory note(s), the security agreement, the pledge agreement and the option agreement. The bureau also requires the disclosure of LMAs in TV assignment and transfer-of-control applications where the proposed licensee intends to operate the station. Subject to the bureau's review of the documentation, applications will be granted depending on the outcome of the attribution rulemaking.

Public inspection file requirements

The FCC requires applicants for new stations, permittees and licensees to maintain a public inspection file. It should be kept at the station's main studio or at another location within the community. The file must be available during business hours.

The following materials must be kept in a station's file for five years:

Applications and related materials:

- Construction permit applications for new stations (FCC Form 301)
- Renewal applications (Form 303-S)
- Assignment or transfer of control applications (Forms 314, 315, 316)
- Construction permit applications for major facility changes (Form 301)
- Requests for additional time to construct new stations (Form 307)
- Applications for changes in program service
- The name and address of any person or group that filed a petition to deny against any of the above applications

Ownership materials:

- Ownership reports (FCC Form 323)
- Articles of incorporation, bylaws or like organizational papers
- Management agreements with independent contractors or employees (if they involve revenue sharing)
- Contracts or other documents relating to the ownership or control of the station
- Network affiliation agreements
- Citizens agreements
- Annual employment reports (FCC Form 395 or 395-B)
- Issues/programs lists
- Time-brokerage agreements

The following items must be kept in the public file for the stated periods of time:

- Political and controversial programming information (2 years)
- Letters from the public (3 years)
- FCC's procedural manual (indefinitely)
- Any documents relating to an FCC investigation or complaint (must be kept until notified by FCC in writing that it may be discarded)

DATELINE: AUG. 1

On or before Aug. 1, 1995, commercial TV stations in the following states must file their annual ownership reports or ownership report certifications with the FCC: California, Illinois, North Carolina, South Carolina and Wisconsin. On or before Oct. 10, 1995, all TV stations must place in their public files their listings of issues and responsive programming for the quarter ending Sept. 30, 1995.

D.C. Circuit upholds cable rates

In a recent court decision, *Time Warner Entertainment Co., L.P., et al.* vs. *FCC*, the D.C. Circuit upheld the FCC's cable rate regulations. The court issued three opinions addressing claims concerning: the rates cable companies may charge under the 1992 Cable Act; whether the FCC's rates violate the First Amendment; the scope of the FCC's cable regulations; and the role of local governments in regulating cable.

In its "rate issue" opinion, the court held that the FCC's cable rate regulations are not arbitrary, capricious or contrary to the act. The court found, however, that the FCC erred in denying cable companies recovery of their cost increases during the period when the act was passed and when it became effective.

The court also rejected petitioners' First Amendment claims. The court concluded that the government had demonstrated an interest in reducing cable rates, and the FCC's regulations were narrowly tailored to meet that interest.

In its "rules" opinion, the court found the FCC misconstrued or misapplied the act in the following ways: the FCC construed the term "effective competition" too narrowly; the FCC erred in concluding that the act's requirement for a uniform rate structure applied to all systems, including those facing effective competition and not subject to rate regulation; the FCC erred in concluding that the statute's "buy-through" provision applies to systems subject to effective competition; and the FCC exceeded its authority by requiring franchising authorities to fund rate regulations out of franchise fees. ■

Harry C. Martin and Andrew S. Kersting are attorneys with Reddy, Begley, Martin & McCormick, Washington, DC. Respond via the *BE* FAXback line at 913-967-1905 or via E-mail to be@intertec.com or by CompuServe at 74672,3124.

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By Rick Morris

Managing a budget, part 2

"How much will it cost?" or "Can we afford to buy it?" are questions often asked of an engineering manager. Much of your job performance is evaluated on how well you maintain the engineering budget. Producing the financial results that the general manager expects is an important part of your role at the station. Constructing and maintaining your department's budget is how you can deliver on that performance.

Creating logical categories

The first thing you need to do is create the proper budget categories. Typical categories may include repair parts, operating supplies, tubes/semiconductors, VTR heads, outside services, shipping and sales tax. You may also have to budget for operating expenses, such as power for the transmitter, satellite uplink time, equipment upgrades, and remote vehicle operating expenses. Examine past expenses to get a base of comparison for each category.

The budget categories should be meaningful, reasonable and trackable. A category is meaningful if you can track items in a way that will show *deviations* that were talked about in Part 1. For example, if you significantly overspend in the "repair parts" category, how would you know if the problem was with the budget or in real life? Budgets are part of preventive maintenance because they can point out equipment that constantly breaks down or if too much money is being spent in any one area.

The budget categories should be meaningful, reasonable and trackable.

Categories must be reasonable. If you have too many categories, you will not be able to see any trends that may develop. (See last month's "Management" column for more information on trends.) Expenses must be trackable in that incoming data must be able to fit within a single category. Keep receipts for every purchase, transaction or repair. Good documentation is important.

Large intermittent expenditures

Few items are replaced every year. However, when big-ticket items need to be replaced, they are by definition, expensive. Camera tubes were like this — they were replaced in sets so they matched — an expensive proposition. Similarly, klystrons/klystrodes are still usually only replaced upon catastrophic failure. Depending on your station, there may be other items that fit this category.

What to do about intermittent, large expenditures is one of the most difficult items to budget for. If you can carry money over from the end-of-year budget, this can make budgeting for expensive items easier. There are also two other possibilities for allowing for expensive items that are not purchased every year:

- Determine what you plan to spend each year and commit to that by buying a certain number of tubes, video heads or other items each year. You may end up with one or two extra items some years, but you can adjust next year's budget line downward. Even in the case of a large item, you would either be replacing a failed part or buying one maintenance spare during the year.
- If an item's cost takes up a large percentage of the engineering budget, like a klystrode, create an engineering contingency line-item the size of one or two klystrodes. If you do not use the funds, they can be returned to the company's bottom line.

Budget commitments and actualities

After you've developed a budget, you have to live within it. This requires a tracking system. You can track your budget manually, but it is simpler and more efficient to use a software program that can handle a volume of data, make changes and forecast "what if" questions. A good spreadsheet program will work fine and is not overly complex.

Why track your own budget? First, because the accounting department at a station can be slow and the content of the reports may be a couple of months behind the real world. Second, vendors are sometimes late in billing. And third, if you let others track your budget, there's a possibility for mistakes. Finally, the unexpected does happen in broadcast facilities, so you need to know with certainty if you can afford it today.

To track your own budget, begin with a column of "*budgeted*" expenses. Also have a column of "*commitments*" against the budget. Commitments are items bought or being bought that haven't been billed yet. It amounts to "reserving" money to be spent, and it is the most important part of budget tracking. When entering "commitments," don't forget to include taxes and shipping or you could end up 10% to 15% short. There also should be a column for *"actuals."* The completed transactions should be entered into this column. Finally, include a column showing year-to-date expenses vs. budget.

As the year unfolds, each category will be either on budget or at a plus or minus deviation. Keep track of the explanations for any deviations; they will be important for the preparation of next year's budget.

Using the budget: Offsets

Sometimes unexpected expenses will arise. You generally have two choices. First, dip into whatever *contingency* funds you have, and second, find a budget *offset*. An offset is giving up something for something else that you need more. If a frame sync cannot be repaired and needs to be replaced but is "out of budget," what can you give up? By using the concept of offsets, your budget stays flexible and you can meet your end-of-the-year goals.

Planning for next year

As you come to the end of the budget year, you will be finalizing your budget for next year. Take all that you learned this year about operating expenses, the data you gathered from your research and budget tracking, and plan for next year. Your budget should be more familiar by now so you can revisit the *trends* and *deviations* with a more knowledgeable eye and make your projections for next year. ■

Rick Morris is an assistant professor of radio/TV/film at Northwestern University. He is a former chief engineer and a former manager of engineering and maintenance for a major TV network. Respond via the *BE* FAXback line at 913-967-1905 or via E-mail to be@intertec.com or by CompuServe at 74672,3214.

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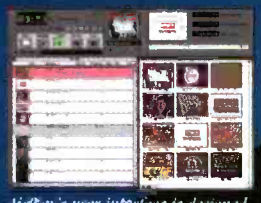

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Circle (14) on Reply Card

By Skip Pizzi, technical editor

Embedding audio in serial digital video

The serial digital interconnection (SDI) standard for video, as specified in SMPTE 259M ("Proposed SMPTE Standard: 10-Bit 4:2:2 Component and 4f_{SC} NTSC Composite Digital Signals — Serial Digital Interface"), includes the ability to *embed* (or multiplex) digital audio signals into the digital video signal. This data is carried in part of the SDI's ancillary data area.

The specifications for embedded audio are further detailed in SMPTE 272M ("Proposed SMPTE Standard: Formatting AES/EBU Audio and Auxiliary Data into Digital Video Ancillary Data Space"), which defines the mapping of AES/EBU-format digital audio signals into the serial digital video signal.

The AES/EBU format has become the single professional standard for uncompressed digital audio interconnection, so its inclusion in the SDI video standard makes sense. But the implementation of embedded audio in various manufacturers' hardware has been problematic. Some of these problems are caused by hardware that does not follow the standard's recommendations, but others are the fault of the standard's insufficient specifications, according to industry experts.

To best understand the nature of these problems and their potential solutions, a brief overview of embedded audio in the SDI is in order.

Embedded audio basics

Embedded audio uses certain portions of the serial digital video signal's *ancillary data* space. When embedded audio data is used, it is configured into *audio data packets* that are placed in these specified ancillary spaces.

In the basic form of embedded audio, 20-bit audio data channels sampled at 48kHz can be multiplexed into the serial digital video signal. The sampling frequency clock for the audio is locked to the video signal in this case. This basic approach (referred to as Level A in SMPTE 272M) allows up to four channels of audio to be embedded in the 4f_{SC} composite mode or up to 16 channels in the 4:2:2 component mode. Generally, these audio channels are configured in AES/EBU digital channel pairs.

Each 20-bit AES/EBU audio data word is grouped with three additional AES/EBU-format bits (the so-called *C*, *U* and *V* bits of the AES/EBU format, indicating *channel status*, *user data* and *validity* (see Figure 1), and the 23-bit group is mapped into three ancillary data words of the serial video bitstream's audio data packet.

A higher level of capability is found in extended embedded audio, which implements all the possible features of the SMPTE embedded audio standard. The four auxiliary bits of the AES/EBU subframe are now included, which offer 24-bit audio sample resolution or other user-specified features. Extended embedded audio also allows non-synchronous audio clocking, sampling frequencies other than 48kHz, the provision of audio/video delay information for each audio channel, channel ID data and audio frame counting. (The latter is used in 525-line systems where there is a non-integer relationship between 48kHz audio samples and video frames). SMPTE 272M defines these extended capabilities in nine different levels of operation (Levels B through J).

Embedded audio hardware can be built to accommodate either the 20-bit (Level A) or the 24-bit (Levels B and C) modes or both. The two formats may be compatible in that some 20-bit systems can accept the 24-bit data but decode only the 20 most significant bits. These devices are said to conform to SMPTE 272M-AB, because they can accommodate Levels A and B as defined in SMPTE 272M. (Level B operation accepts the extended data packets of 24-bit operation, but does not use the data contained in them.) On the other hand, 24-bit systems can set the four least significant bits to zero when they encounter 20-bit data. Such devices are said to conform to SMPTE 272M-ABC.

Multiplexing the audio data into the digital video bitstream is handled differently in composite vs. component formats. In the composite format, the audio data is carried in ancillary data space provided in the horizontal sync period. In the component format, where more ancillary data space exists, embedded audio is placed between the *end of active video* (EAV) and *start of active video* (SAV) words. This is why the component format can carry more audio channels (12 channels of 24-bit AES/EBU or 16 channels of 20-bit AES/EBU).

Digital audio can be reclaimed from the SDI signal for processing at any point using a demultiplexer. This device deserializes the signal and strips out the audio data, clocking each AES/EBU channel's data into a buffer at the proper ancillary data interval. A microprocessor then takes the audio from the buffers, adds the proper AES/EBU subframe header data and re-serializes it

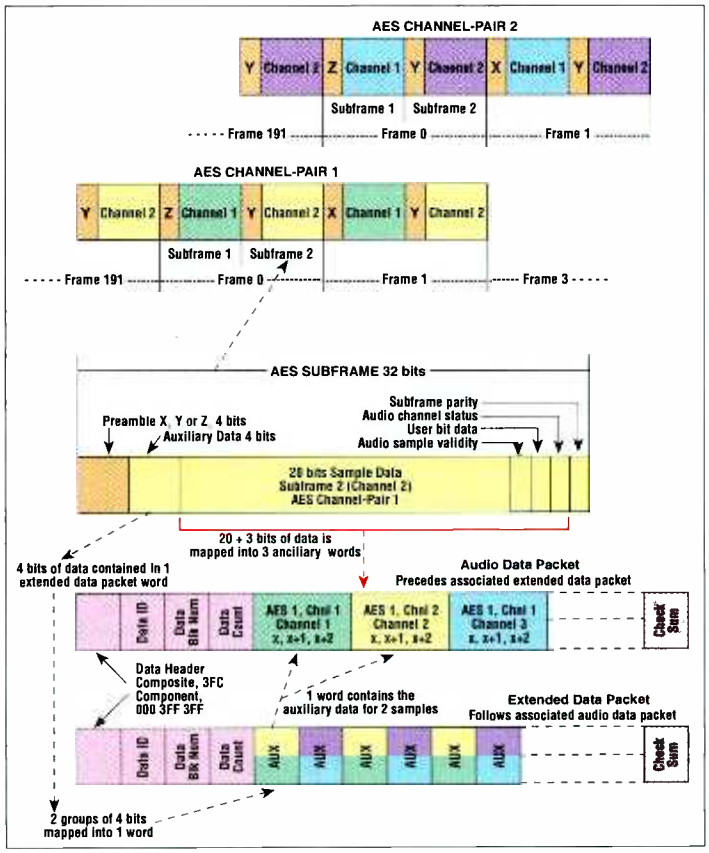


Figure 1. The mapping scheme of AES/EBU digital audio into the audio data packets of serial digital video. The extended data packets (bottom) do not appear in Level A (or "basic") embedded audio. (Source: SMPTE 272M.)

as an audio-only signal. Finally, an AES/EBU transmitter restores the data format to full AES/EBU specifications, typically clocking it out at a 48kHz sampling frequency locked to the incoming video signal.

This process causes the audio signal to be delayed relative to the video. The amount of the delay is typically less than 10ms, however, this should not be problematic unless the mux/demux process is applied to the same signal numerous times.

Pros and cons of embedded audio

The major advantage of embedding audio into the serial digital video signal is the ability to transport a complete digital TV signal (including multichannel audio) in composite or component form on a single cable. In fact, this may be the *only* advantage of such an approach, and depending on the application, it may be outweighed by a greater number of disadvantages. Among the latter are the following:

- The cost of the multiplexing and demultiplexing equipment for embedded audio is significant.
- Audio delay is added each time the embedded audio is recovered from the serial digital video signal.
- A higher degree of vigilance in facility-wide synchronization is required for problem-free audio.
- In the NTSC world, the non-integer relationship between video and 48kHz digital audio signals can create additional difficulties.
- Embedded audio systems are prone to problems due to implementation inconsistencies between manufacturers (see below).
- "Hot switching" of serial digital video signals with embedded audio can cause audio glitches even when everything is properly timed and compatible.

For these reasons, embedded audio is probably only worthwhile in large facilities where digital audio and video systems already proliferate, and where fully produced signals are mainly passed through. It is also helpful if the facility's digital equipment is of uniform or fairly similar type and manufacture, the facility is well-synchronized throughout, and hot on-air switches are rarely required.

This implies that embedded audio makes sense for a network switching center of recent vintage. By similar reasoning, embedded audio may be inappropriate at a typical TV station or small post-production facility with a variety of equipment.

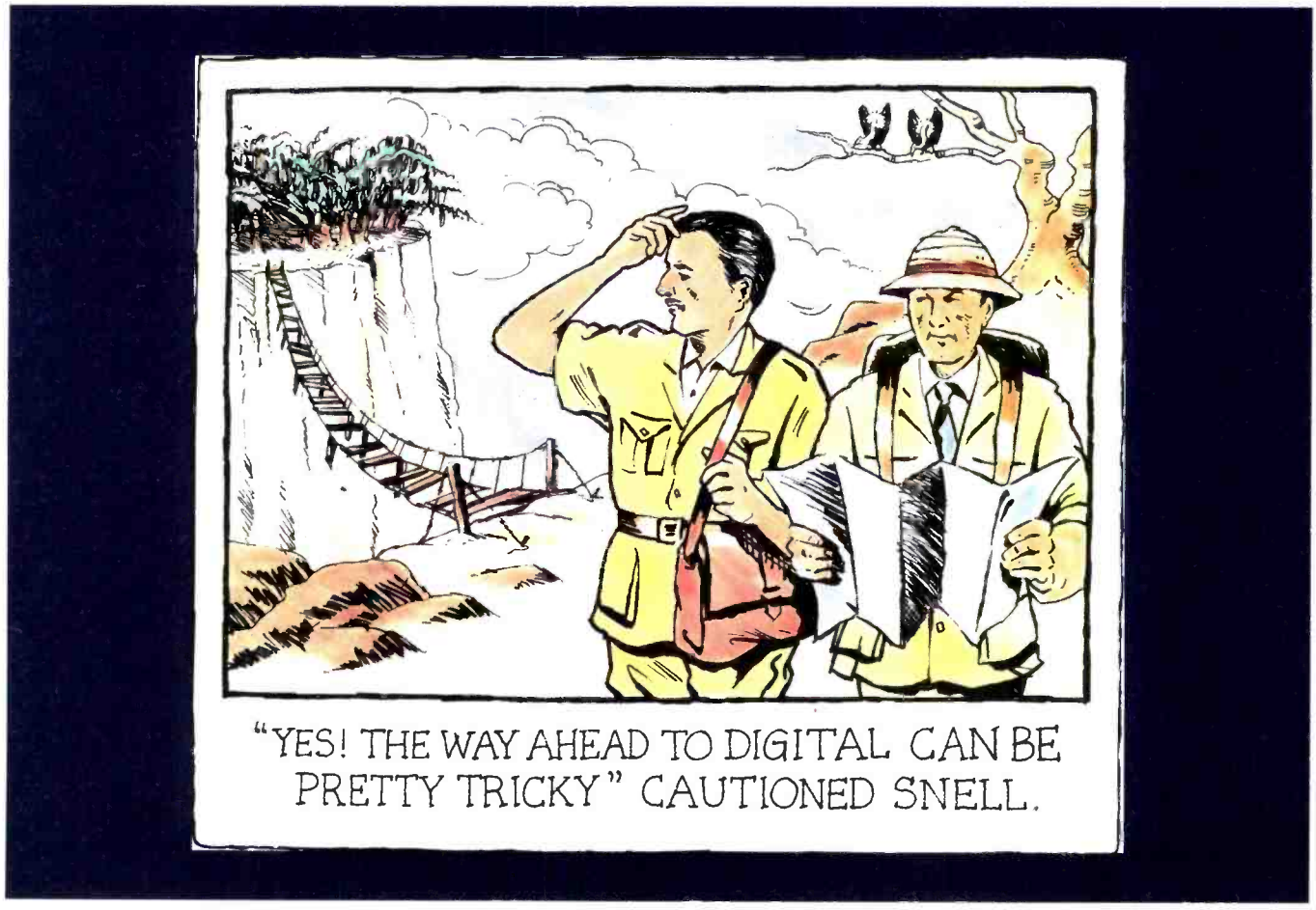
At the large facility, the use of embedded audio means that several levels (typically two or four) of the main router may be eliminated, because audio channels do not flow through the switcher independently. This can reduce the cost of the router substantially.

Yet, at a large broadcast facility, the master control switcher will still require a number of audio-only and video-only sources, and independent audio/video routing will generally be required at some point. Every place that independent audio I/O is needed in the embedded-audio facility will require mux and/or demux hardware. The cost of this equipment can add up quickly, reducing or perhaps wiping out the savings in the main routing system.

To cope with this conundrum, switcher manufacturers are developing compromise solutions. One such system includes internal, assignable mux/demux channels and an independent digital audio/video switching matrix that lives within the serial digital router, allowing efficient selection of either independent or embedded digital audio signals from the desired sources.

Problems in implementation

Assuming that embedded audio is appropriate for a given facility, problems may still occur during operations. These are typically manifested as clicks or pops in the audio during switches between devices made by



different manufacturers.

The most vexing cause of this comes from some serial digital equipment that is not built to the specifications of SMPTE 259M. In these cases, audio data packets appear in areas (i.e., on video lines) where they are not supposed to be placed according to the ancillary data specifications of the SDI standard.

But even with equipment that *does* follow the standard, similar problems can still occur when switching between mixed-manufacturers' products. This is apparently caused by insufficient specificity in SMPTE 259M and 272M, which define the video lines that audio data packets should appear upon, but do not specify how many audio samples should be included in each packet and line. These details are left up to equipment designers. Unfortunately, different manufacturers have come up with different implementations, which can sometimes cause disruptions in the embedded audio when a switch is made between one manufacturer's hardware and another's. (Such problems have also occurred elsewhere in digital video interfacing, where manufacturers have interpreted other parts of the SDI standard in conflicting ways. In digital audio systems, the DAT format suffers from similar intermachine ancillary data incompatibilities, as well.)

In the NTSC composite SDI environment, an additional problem comes from the non-integer relationship of audio samples to video fields, as mentioned earlier. The distribution of embedded audio data in this format is such that it takes five NTSC fields before a non-fractional number of audio samples (8,008 samples) is accumulated at a frame boundary. Statistically, this means that four out of every five switches will be problematic, unless all routing can keep track of fields and only switch on the proper field boundaries. This will not always be possible, but it contributes to the need for a higher degree of synchronicity in the facility.

Solutions

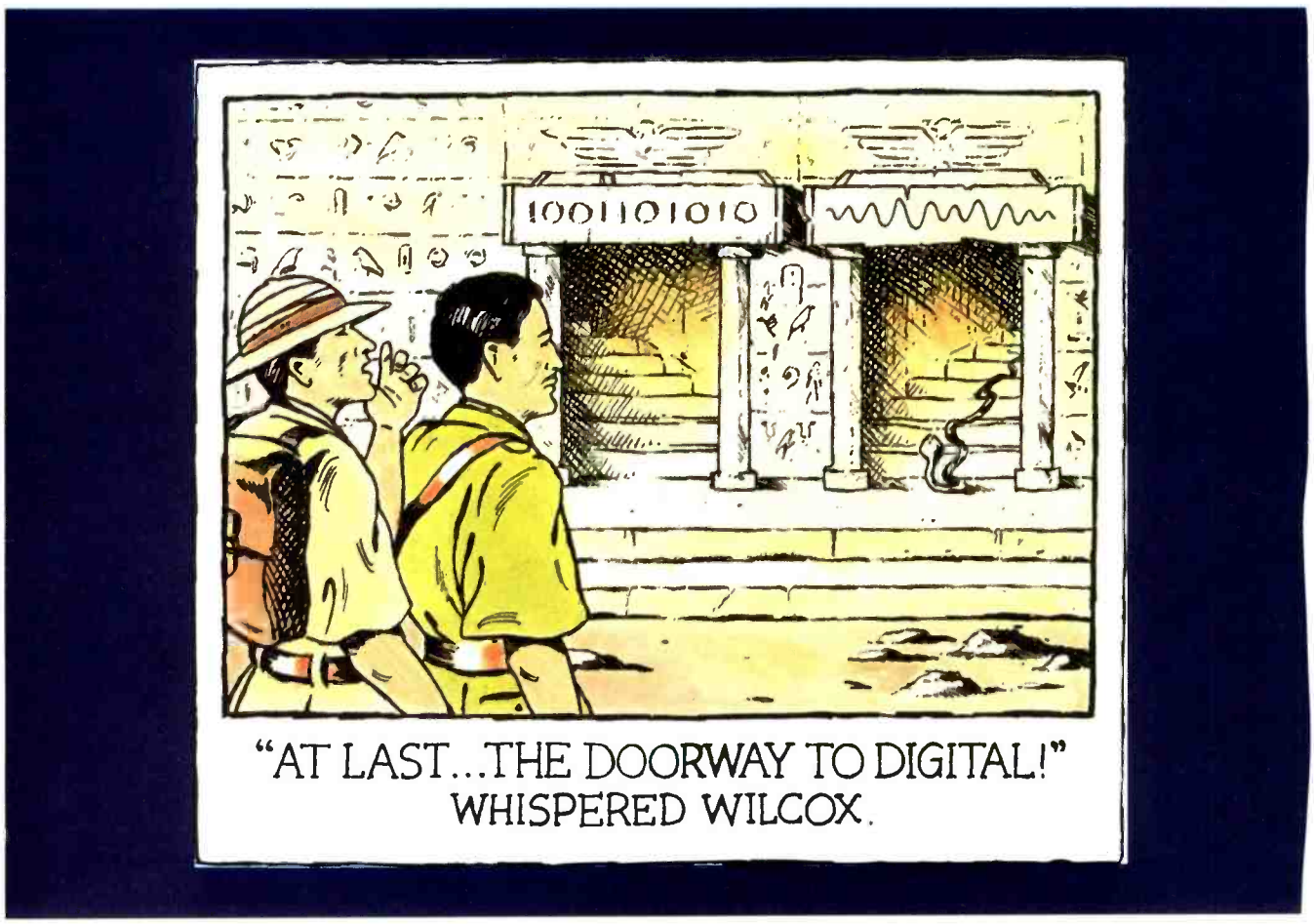
For embedded audio to work properly, a facility first needs to make sure that all of its equipment conforms to SMPTE standards for SDI ancillary data. Next, the facility must properly synchronize all of its source machines, embedders, routing switchers, demultiplexers and AES/EBU house reference.

Finally, remember that it only takes the corruption of a single audio *sample* (not a whole frame or subframe) to cause an audible glitch in the embedded audio. This means that even if everything is properly synchronized and all equipment operates compatibly, embedded audio problems can still occur because a hot switch between two digital audio signals still bridges two waveforms. Synchronization only ensures that the frequency-domain axis of the two waveforms will merge smoothly, but it does not guarantee that the *amplitude* of the two waveforms won't be inherently different, thereby creating a pop in the audio at the switch point.

Analog systems have allowed users to get away with hot switching of audio, but digital systems are generally not so forgiving. For this reason, the ultimate solution will probably involve DSP-based crossfading in the audio switching paths of serial digital routing systems.

In summary, be on the lookout for problems when trying to implement embedded audio in a serial digital video environment. Make sure that it's worth the trouble and expense for your application, and then verify that your equipment types and your facility's timing are up to the task. Even then, expect an occasional glitch if you do any hot switching of embedded audio signals.

Respond via the *BE* FAXback line at 913-967-1905 or via E-mail to be@intertec.com or by CompuServe at 74672,3124.



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By Peter Zawistowski

"Green" batteries

During the 1980s, few people were concerned about the toxic materials in batteries and little thought was given to their disposal. But now, with a growing emphasis on protecting the environment, the use of toxic materials in batteries has been reduced or eliminated. This has resulted in changes in certain battery composition as well as the discontinuance of some batteries.

Toxic materials

The most common types of non-rechargeable batteries, normally called dry cells, are the alkaline and the "general-purpose" types. Both use the same materials, manganese-dioxide and zinc, but differ in material purity and electrolytes used.

Until recently, these dry cells contained mercury to prevent hydrogen outgassing that caused cell rupture and leakage. Manufacturers of alkaline batteries have removed all mercury from the cells except for trace amounts that occur naturally in the metals. Tons of alkaline batteries are disposed of yearly, and alkaline batteries are not economically recyclable at this time; more pollution would be created in the recovery process than would be saved.

Recently, lithium AA batteries have appeared on the market and are used in high-drain applications such as cellular phones, 2-way radios and electronic flashes. Although lithium batteries cost roughly 2.5 times the cost of alkaline batteries, they maintain a constant voltage over a greater period of time. Estimates of the constant output from lithium types are near 80% of their usable life while alkaline cells maintain a constant output for only 20% of their usable life. Lithium cells also operate better than alkaline in extreme hot and cold environments.

Environmentalists are concerned about lithium, an extremely active metal, but keep in mind that there are several lithium battery chemistries. Some contain toxic materials such as sulfur-dioxide. In order to continue the use of these batteries, industrial users will have to seek out ways to recycle the materials used in the batteries.

The familiar Mercuric-oxide, Hg button cells used in many cameras are now banned in at least 13 states. Voltage-sensitive applications used the Hg cells as memories for white-and-black balance, auto-registration, light meters and hearing aids. These little batteries had a uniquely constant output voltage. With a 1.34V output over the life of the battery, there was no need for a voltage regulator with this battery. A possible replacement for the Mercuric-oxide battery is the Silver-zinc. It has a 1.84V output and its useful life is shorter than the Mercuric-oxide battery.

Are you ready to say so-long to soldered-in batteries? Soldered-in batteries on a printed circuit board do not meet today's recycling guidelines. SGS-Thompson has introduced the "Snaphat" package as a replacement for soldered-in PC-board mounting. The "Snaphat" is used with surface-mount PC boards where reflow soldering techniques would expose the batteries to excessive temperature. Presently, non-rechargeable lithium batteries are being manufactured. A side benefit of this package is easy battery replacement and cell standardization.

Battery labeling requirements

Manufacturers of rechargeable batteries must comply with labeling requirements. On the outside of a rechargeable battery, the type (chemical) must appear, such as NiCad for Nickel Cadmium. NiCad and the newer nickel-metal hydride (NiMH) are environmentally friendly because of their ability to be recharged and reused. NiCad batteries have been with the broadcast industry for many years and set the standard for other types. Many people classify the NiCad as hazardous waste material, but reuse/recycle programs will help keep this battery type on the market.

Due to its recent introduction, the NiMH cell has not been classified as hazardous material yet. It costs nearly twice as much as a NiCad but delivers 25% to 40% more run time compared to the NiCad. NiMH batteries are currently available for OEM use only. They are being supplied with some 8mm and VHS-C camcorders.

Recycling NiCads

The automotive lead-acid battery industry recycles at a rate of 95% or higher. If the non-automotive industry could come close to the same recycling rate with NiCad batteries, the NiCad would do less harm to the environment then the more "environmentally friendly" NiMH, at a lower cost to the user.

The manufacturers of NiCad and sealed lead-acid batteries recognized the need to work together on environmental issues and formed the Portable Rechargeable Battery Association (PRBA). This trade association deals with the environmental concerns associated with batteries.

The Rechargeable Battery Recycling Corporation (RBRC), a not-for-profit corporation, was created to manage the industry-wide recycling program. The RBRC's seal of three arrows around a battery with the battery's chemistry indicates that the battery can be handled by the industry recycling program. Check your batteries — if they do not have this seal, ask the manufacturer or the distributor why they are not participating in the RBRC program. The RBRC manages battery collection programs for rechargeable small sealed NiCad batteries nationwide. The corporation plans to divert a large percentage of the batteries available from the waste stream through collection, education and recycling programs. It currently has pilot programs in place in New Jersey and Minnesota.

Because of a growing emphasis on environmental planning and conservation, the use of toxic materials in today's batteries has already been reduced. As recycling techniques improve, the amount of waste material produced by batteries will continue to be reduced and more resources will be conserved. ■

Peter Zawistowski is senior engineer at Target Enterprises, a remote production engineering and design firm in North Reading, MA. Respond via the *BE* FAXback line at 913-967-1905 or via E-mail to be@intertec.com or by CompuServe at 74672,3124.

Sources for more information

Portable Rechargeable Battery Association (PRBA), 1000 Parkwood Circle, Suite 430, Atlanta, GA 30339; Phone 404-612-8826; Fax 404-612-8841

Rechargeable Battery Recycling Corporation (RBRC), 704-A Hope Road, Stafford, VA 22554; Phone 703-720-9225; Fax 703-720-9324

International Metals Reclamation Company (INMETCO), John Liotta; Phone 412-758-2802; Fax 412-758-9311
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Duracell International Inc., David Barrett, Berkshire Corporate Park, Bethel, CT 06801; Phone 203-796-4000; Fax 203-730-8958
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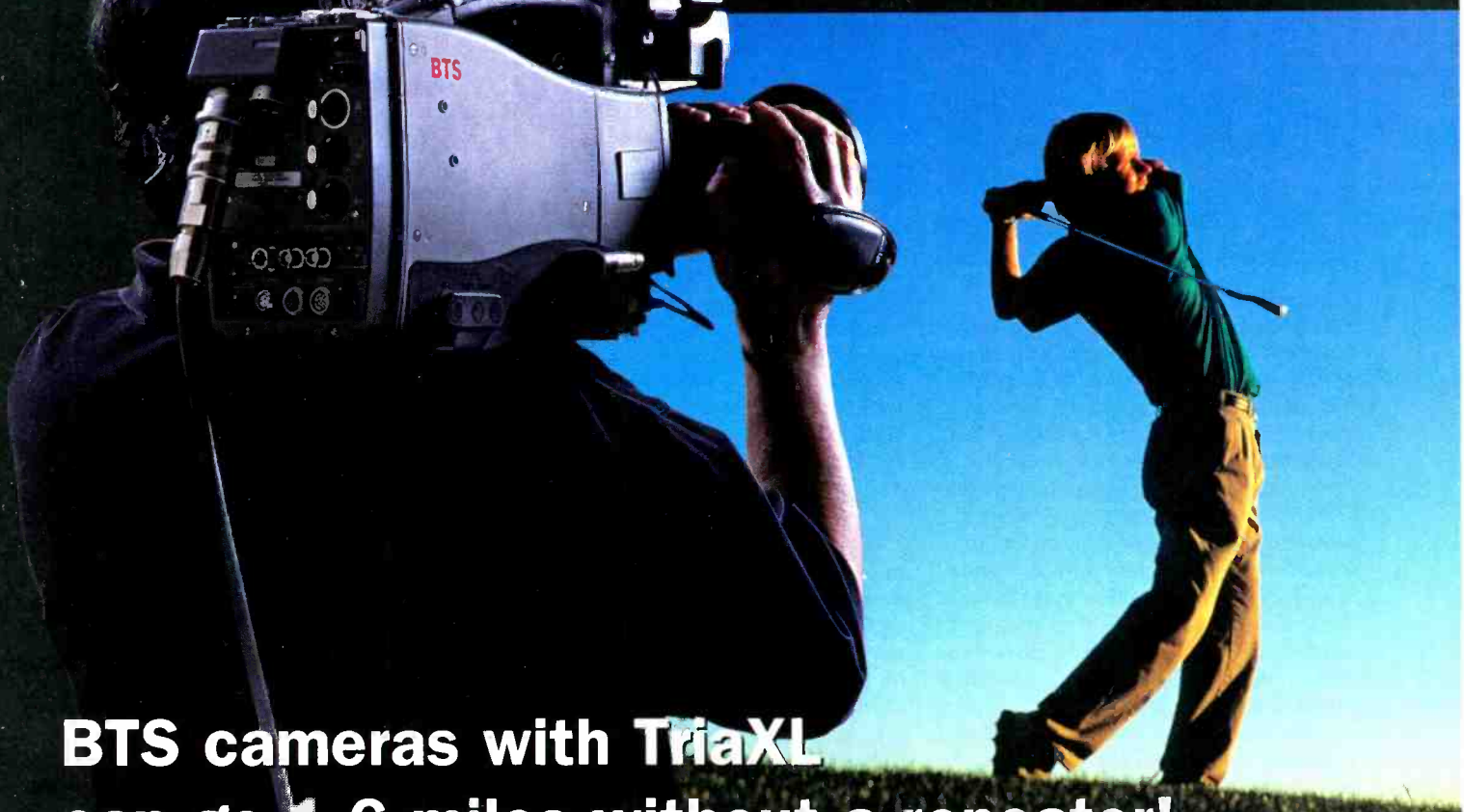

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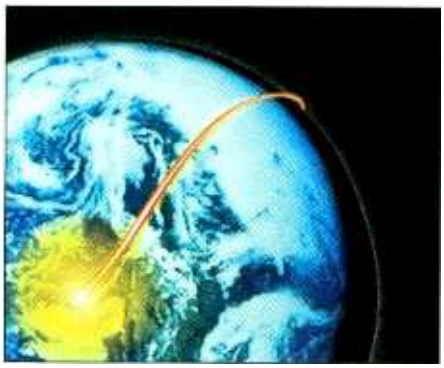

Sending E-mail

One of the new ways your station can become interconnected with its audience, advertisers, suppliers, consultants, syndicators and networks is via electronic mail or E-mail. E-mail is probably the simplest form of electronic interaction that is offered by the worldwide Internet computer network.

There is only one Internet. Virtually any commercial, government, military, non-profit and foreign organization with any kind of E-mail connectivity is interconnected to it. Anyone with a valid E-mail address on the Internet can send a message to anyone else with a valid E-mail address. All commercial E-mail and on-line services are also connected, even cutthroat competitors. E-mail that originates from an AT&T address can be sent to a subscriber of MCI Mail.

How E-mail is addressed

Electronic mail uses a hierarchical addressing system that avoids duplication of personal or business addresses. My Internet E-mail address (gmonti@cais.com) contains my user name on that system followed by the @ sign, the name of the system or "site," and the "domain" in which it falls. The organization is Capital Area Internet Service (cais) and the domain ".com" says that it's a for-profit business. Other domains include .org (non-profits), .gov (non-military government), .mil (military) and .net (network services providers). Internet addresses outside (and some inside) the United States often have a 2-letter country code appended to the end to help prevent duplications between nations. There are no spaces in E-mail addresses. As with an international telephone number, my address is the only one spelled exactly like it in the world.

Getting connected

To get connected to E-mail, the first thing you'll need is an E-mail service provider. Several types of services offer Internet E-mail connectivity.

Some commercial on-line computer services include:

- CompuServe (800-848-8199 or 614-457-8600)
- America On-Line (800-827-6364 or 703-448-8700)
- Prodigy (800-776-3449)
- Dow Jones News/Retrieval (800-522-3567 or 609-452-1511)
- Delphi Internet (800-695-4005 or 617-491-3342)
- GEnie (800-638-9636 or 301-251-6475).

Some commercial Internet service providers include:

- UUNet Technologies (800-488-6384 or 703-204-8092)
- Netcom (800-353-6600)
- PSINet (800-774-0852 or 703-709-0300)
- Digital Express (800-969-9090)
- CERFNet (800-876-2373)
- The Pipeline (212-267-3636)

Some of these services offer connectivity in major cities while others serve only a single media market. To find others, look in computer magazines or in computer advertising sections of major newspapers. Local bulletin board services (BBSs) may have Internet connectivity, but they probably don't offer it to businesses.

Questions to ask prospective E-mail providers should include:

- How will my E-mail address appear? Would you rather be known as "3456@provider.net" or as "xyzcorp@largenet.com" or as "newstip@wxyz.com?"
- Is there a limit to the number of E-mail messages or megabytes of disk storage space I can use on the service provider's computer? What are the charges for using more?
- Will a computer at my broadcast station become a "node" or part of the Internet or will I dial in on a modem to a provider's computer which is, in turn, part of the Internet?
- Am I limited to using dial-up modem speeds (generally 14,400 bits per second) on analog lines? Or should I put in a digital dial-up phone line like Switched-56 or ISDN (64,000 or 128,000 bits per second)? Or should I have a dedicated data circuit? Do I order and pay for data circuits myself or does the provider do it and bill me?
- What will the service cost per month? Some providers are offering E-mail-only accounts to individuals using analog dial-up lines for as little as $7 per month. Some are offering 56kb/s access to all Internet services, not just E-mail, to small businesses for about $700 per month.

Why send E-mail?

E-mail is slower than a fax message, less expensive than a phone call and faster than the Postal Service. With E-mail, the recipient receives an electronic text file that can be edited, replied to, excerpted or even pasted into a word processor or spreadsheet document.

Using mail software on a PC or server to compose and send a short E-mail message anywhere in the world is amazingly quick and easy. You can send an order confirmation to an advertiser or agency, answer a viewer question, forward mail to another department or send a question to a syndicator or network in a few minutes. There are no printers to wait for, no envelopes to type, no stamps to find and no pickups to wait for.

Sometimes this results in you or your staff being "too quick" to respond, which can result in an incomplete or opinionated answer. You'll need to remind your staff that, in essence, all E-mail leaves the premises on your corporate "electronic stationery" and may be perceived as the opinion of your company or station no matter how many disclaimers are included.

Internet E-mail messages will take from five seconds to five days to be delivered, although most will be delivered in a few hours. If even one character of the address you send E-mail to is out of place, it will "bounce" back to you with a cryptic message indicating whether the site name or the user name are wrong.

E-mail etiquette

Because access to the Internet is usually flat-rate priced, you could send one or 1,000 messages a month. Your mail software may allow the sending of many duplicates of the same message, but don't plan on sending mass advertisements by E-mail yet. The Internet community frowns on it, and many people may send angry replies, called "flames," to punish you for violating etiquette. The no-commercialization concept dates from the time when the Internet was a government network for defense and research. Recent developments seem to indicate more tolerance toward commercial use. Don't worry about using E-mail to contact individuals or firms with whom you already have a business relationship.

When you reply to an E-mail message, you may include excerpts of the text from the message that was sent to you. This allows you to "annotate" the sections to which you want to respond. If you do this, keep the amount of original text to a minimum. ■

Greg Monti is technical manager of National Public Radio's Future Interconnection System Project Office, Arlington, VA. He may be E-mailed at gmonti@cais.com. Respond via the *BE* FAXback line at 913-967-1905 or via E-mail at be@intertec.com or by CompuServe at 74672,3124.

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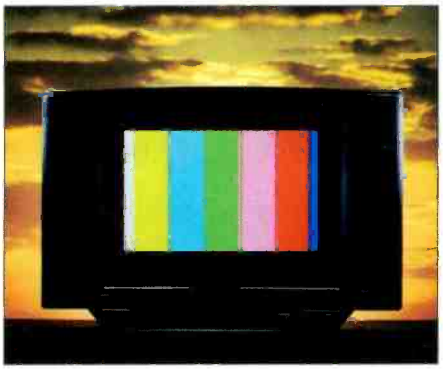

A new modulation technique for ATV?

Digital data transmission has long been known to offer many advantages over analog transmission. Digital modulation is an outgrowth of the more familiar methods of analog modulation such as amplitude, frequency and phase modulation. Of particular concern to broadcasters is how to deal with the primary channel impairments due to multipath interference, co-channel interference from existing analog services, and impulse interference and compensate for the potential shrinkage inherent in the move from VHF to UHF.

Digital transmission is also complicated by UHF propagation characteristics, severe terrain shadowing and the need for improved levels of location and time availability to compensate for the ATV reception abrupt failure mode in weak signal areas. Careful planning is essential to render terrestrial ATV competitive with other delivery media. The challenge includes development of a digital broadcasting service that accommodates a high data rate such as that required by a single-channel HDTV service and delivers it reliably within the coverage area.

In NTSC, an analog system, the planning of the service and selection of the modulation scheme seek to establish a signal level at the receiver that exceeds the likely level of noise and interference by a large enough margin that the noise and interference contribute insignificantly to impairments. Also, the transmit/receive antennas and transmission path are arranged so that a minimum of echoes are received.

For the broadcast system, using digital modulation, improved reliability and availability of coverage as well as greater spectrum efficiency may be achieved by the use of a different approach. One of the most promising among such technologies is Coded Orthogonal Frequency Division Multiplexing (COFDM), which originated in the U.S. telecommunications industry and has been extensively developed elsewhere for Digital Terrestrial TV Broadcasting (DTTB).

In 1994, a group of broadcasters, in an effort to optimize coverage under all conditions, formed a development project to explore alternative transmission techniques for digital terrestrial television. The main objective of the group was to determine the best approach to optimizing coverage and system reliability while also achieving a high level of spectrum efficiency. A transmission subsystem using multiple-carrier COFDM techniques has been built and may be considered as part of the FCC Advisory Committee on Advanced Television Service (ACATS) process for use in the North American terrestrial TV environment.

COFDM's possible advantages

The COFDM transmission subsystem offers features that are of potential special benefit to terrestrial broadcasting. The COFDM system design accommodates two inherent characteristics of terrestrial transmission: 1) multipath echoes are virtually unavoidable, and 2) existing services and co- and adjacent-channel concerns impose constraints when new services are introduced. Conventional transmission systems attempt to recover a main signal and reject received echo signals. COFDM systems attempt to take advantage of all transmission paths.

The three main advantages of COFDM for broadcasters appear to be:

1. The ability to operate more reliably in an environment of strong multipath conditions;
2. The possibility of employing on-channel repeaters (gap-fillers) to extend the coverage of underserved areas, or extend coverage without the need for directional receiving antennas;
3. The flexibility to tailor the emission to reduce the effect of undesired interference.

How COFDM works

The useful data rate achievable in a COFDM system is a function of the number of interrelated parameters that can be selected to optimally match the performance to the specified application. Such parameters include the modulation type applied to each carrier, the guard interval and symbol durations, the channel coding rate, the channel bandwidth and the number of carriers. The description of parameters selected for use in the COFDM-6 system provides an optimal balance of data rate, forward-error-correction and channel utilization.

An accurate assessment of the capabilities and comparative advantages of COFDM awaits further testing of both COFDM itself compared to related aspects of the competing single-carrier technologies now in use by the Grand Alliance.

The main objective of the project is to develop an alternative transmission subsystem designed to enhance the performance of the Grand Alliance system currently under con-

Parameters	System A (On-channel SFN)	System B (Single transmitter)
Channel bandwidth	6 MHz	6 MHz
Actual used bandwidth	5.6 MHz	5.6 MHz
FFT size	8k	4k
Useful symbol duration	1101.607 μs	555.179 μs
Symbols per frame	105	105
Total frame duration	122.390 ms	60.927 ms
Guard interval period	64.0094 μs	25.0752 μs
Total number of carriers	6169	3109
Carrier spacing	0.9708 kHz	1.8012 kHz
Number of reference pilots	49	49
Reference symbols per frame	3	3
Constellation of all carriers	64 QAM	64 QAM
Trellis coding rate	0.66666666667	0.66666666667
Payload data rate	≈19+ Mbps	≈19+ Mbps

Table 1. Two preliminary system parameters for the COFDM transmission system.

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sideration. This enhancement makes use of multicarrier COFDM techniques. This new module would thus be functionally equivalent to the current transmission subsystem, which is based on single-carrier techniques, and will thus facilitate side-by-side comparisons in the laboratory and in the field under a wide range of conditions.

Preliminary information suggests that COFDM could improve upon the single-carrier technology currently in place in the Grand Alliance system in a number of important ways. It could yield improved flexibility in the delivery of digital TV services and improved levels of service, and yield more optimal use of spectrum. COFDM may be better than single-carrier systems in the elimination of ghosting, thereby providing improved multipath immunity; in the provision of increased coverage to hard-to-reach areas through the use of low-power, on-channel repeaters; and in avoiding the drawbacks of one high-power, centrally located transmission site by the substitution of lower-power transmitters at a number of sites.

From a planning perspective, the multicarrier COFDM technique will offer broadcasters the opportunity to retain their current coverage and audiences as they move from VHF to UHF channels. It will also improve the availability of signals and their reliability in difficult terrain.

The use of low-power, on-channel repeaters may yield a further benefit by the replacement of translators, on which many stations, including many non-commercial ones, rely. Because these translators will not be allotted ATV spectrum, selection of a technology that makes such allocations unnecessary serves an important public interest.

Two possible systems

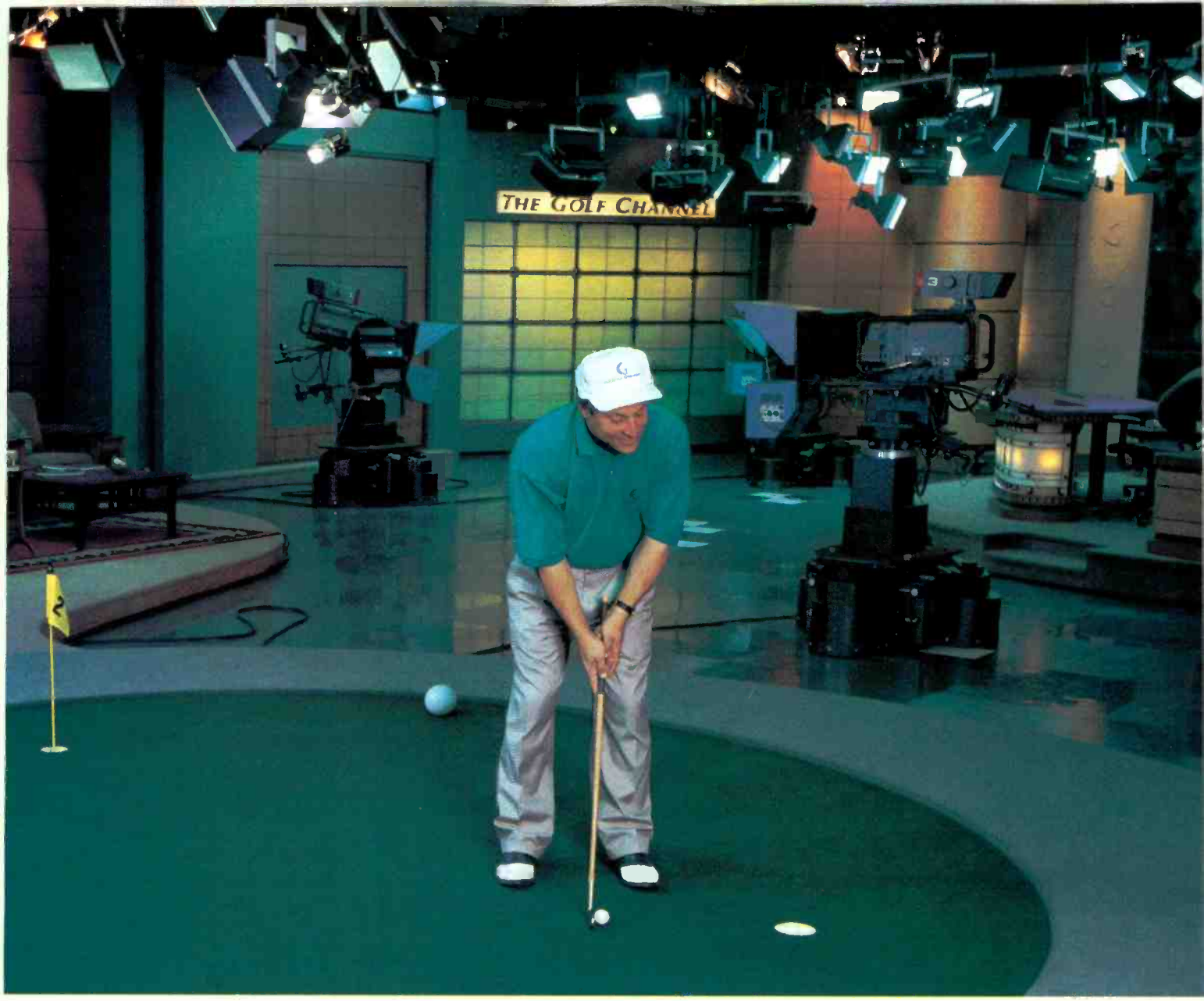
Table 1 lists two preliminary system parameters for the COFDM transmission system. The two sets of parameters represent two different implementations. The final system testing will finalize a set of system parameters. Compromises will be made among guard interval duration, data throughput, carrier spacing, robustness to dynamic multipath distortion, number of in-band pilots required, acquisition time, phase noise, etc.

System A is optimized for local Single Frequency Network (SFN) and on-channel coverage extender environment. The long guard interval (64μs) will enable the receiver to properly recover signals received from two synchronized stations. Approximately 6,000 carriers will be required resulting in a narrow carrier spacing (1kHz). The useful symbol duration is approximately 1ms. An 8k FFT is required.

The second system, known as System B, is optimized for use in a conventional, single transmission-tower approach. System B has a reduced guard interval (25μs), a larger carrier spacing, and requires about 3,000 carriers and offers greater robustness to general RF channel interferences. The 25μs guard interval may not be long enough to accommodate the rarely seen long delay (30μs) echoes that have been reported in the non-SFN environment. Studies indicate that a COFDM system can withstand an echo that falls out of the guard interval for no more than 1-2% of the useful symbol duration. For this configuration, a multipath delay up to 35.8μs (25 + 540 x 0.02) can be accommodated. A 4k FFT is required.

Next month, I will discuss in more detail the technical parameters of COFDM and the 8VSB Grand Alliance transmission subsystem. ■

Louis Libin is the director of technology at NBC, New York. Respond via the *BE* FAXback line at 913-967-1905 or via E-mail at be@intertec.com or by CompuServe at 74672,3124.



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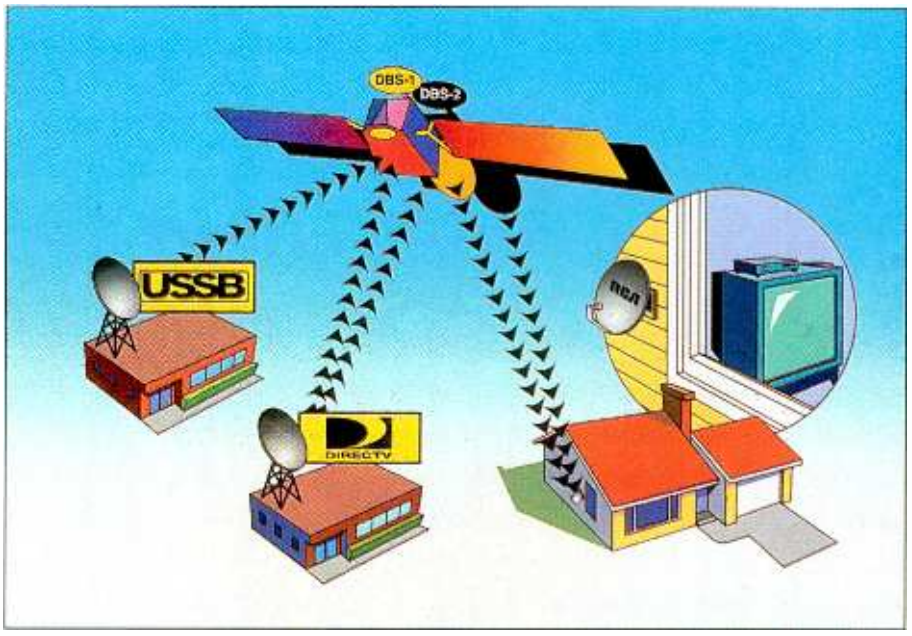
Digital Satellite System

The flying high DBS success story is delivering new opportunities for consumers and broadcasters.

By Marjorie Costello



As we await the construction of the wired information superhighway, an approach that literally falls from the sky is already taking off: Digital Satellite Service (DSS). DSS is becoming one of the most successful consumer electronics launches of all time. In its first six months, sales of home DSS equipment were higher than first-year sales for VCRs, color televisions and CD players.

DSS was launched nationally in October 1994 as the world's first all-digital TV programming service and North America's first high-powered direct broadcast satellite (DBS) service. By the end of 1994, nearly 600,000 RCA DSS systems had been shipped to dealers, who could not keep up with demand.

DSS is also a major success story in broadcasting: the programming and distribution powers behind DSS are industry veterans, GM Hughes Electronics and Hubbard Broadcasting, through new divisions, DirecTV and USSB, respectively. On the receiving end is consumer electronics powerhouse Thomson and its RCA brand. Thomson not only designed, manufactured and marketed the first home DSS equipment, the company also developed the patented compression technology used for DSS. By this summer, when RCA is expected to reach one million systems shipped, Sony's consumer division will start marketing DSS equipment.

With DSS flying high, direct-to-home satellite delivery may finally be in the driver's seat on the information highway. This is especially significant as telcos and cable companies scramble for the mega billions to build their earthbound lanes.

Direct-to-home satellite delivery may finally be in the driver's seat on the information highway.

The hardware and programming

Consumers equipped with RCA's 18-inch "pizza-size" dishes and DSS receivers can receive 175 channels of digital-quality pictures and CD-quality audio sound. The programming includes major cable networks as well as pay-per-view movies and more than 25 channels of commercial-free CD-quality music.

DSS is transmitted via two high-powered Ku-band direct broadcast satellites — DBS-1 and DBS-2 — launched by GM Hughes in geosynchronous orbit over the equator at 101° west longitude. DirecTV shares DBS-1 with USSB, with DBS-2 used exclusively by DirecTV. The system was launched using MPEG-1 compression.

DirecTV's 150 channels are transmitted from its Castle Rock Broadcast Center in Colorado. Castle Rock receives national cable channels via satellite and converts them into digital transmissions for DirecTV's so-called "turnaround" channels. DirecTV also offers more than 50 pay-per-view movie channels played back on many of Castle Rock's 300 Digital Betacam machines.

Operating east of St. Paul is USSB's facility in Oakdale, MN, built specifically for DSS. USSB's 30 channels include multichannel versions of premium services such as HBO and Showtime. Betacam SP is the house format used to play back USSB program promos, which like DirecTV interstitial material, is shown in place of the local cable "avails."

One DirecTV programming option of particular interest to TV stations is Primetime 24. It's a package of five broadcast affiliates representing the major networks: WABC-TV (ABC, New York); WXIA-TV (NBC, Atlanta); WRAL-TV (CBS, Raleigh); WFLD-TV (Fox, Chicago); and KRMA (PBS, Denver).

Following the guidelines of the Satellite Home Viewing Act of 1988, only DSS customers who can't receive their local broadcast TV channels can pay $3.95 to get the package. Local broadcast affiliates are sent reports by Primetime 24 with the names of all the people in their market who are signed up for the service.

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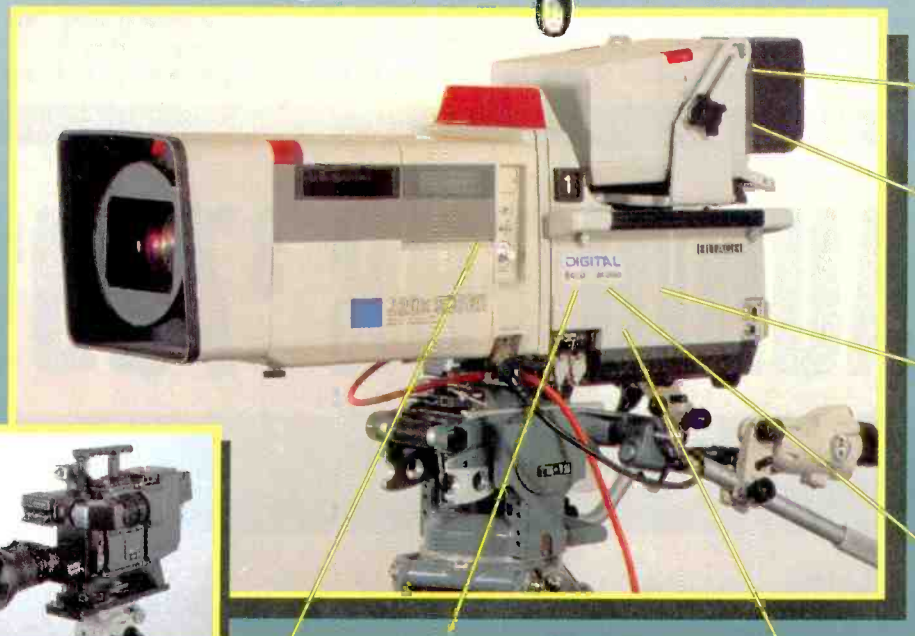

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A home installation: it's just that simple

A DSS system starts at $699 and a deluxe system that permits dual hookups through a second receiver can be purchased for $899. The price includes the dish and the receiver and a second receiver runs $649. Thomson is also starting to market DSS systems designed for multiple-unit dwellings.

Consumers can set up their own DSS system with a self-installation kit available at retail for $69.95. RCA says that many consumers — about 70% — are using professional installers, who charge from $150 to $200 (broadcast engineers would find a DSS installation child's play).

Consumers clamor for dishes

Although it is too early to tell what the long-term effect of DSS will be on broadcasters and cable, several patterns are already emerging.

The strong appeal of DSS is reflected by an independent source in a recently completed consumer study conducted by IMR Research, *Home Audio/Video/Computer Product Planner's Notebook*. The Clarendon Hills, Illinois-based firm has been providing market research to consumer electronics companies for many years. When IMR asked consumers about consumer electronics products they did not yet own, nearly 60% of the respondents said they wanted a mini satellite/DSS dish making it the number one choice.

Consumers equipped with a Digital Satellite Service receiver and an RCA 18-inch dish can receive 175 channels of digital-quality pictures and CD audio sound.

DirecTV and USSB estimate that 50% of their subscribers are in cable areas, and half of them are dropping their cable service. This trend is supported by the IMR Research study, which indicated that nearly 70% of respondents expressed interest in getting their TV signal through satellite dish rather than cable television. This information foreshadows major problems for cable operators that could benefit DSS as well as over-the-air broadcasters.

A broadcaster's perspective

In discussions with Hubbard Broadcasting, it became clear the company would not have invested reportedly $200 million in USSB if they had perceived it as a threat to their core business. (General Motors, Hughes's parent company, has spent $750 million on DirecTV.) The 72-year-old Hubbard Broadcasting owns nine TV and two radio stations, as well as Conus Communications. Conus's All News Channel, fed to stations across the country, is also part of the USSB programming lineup.

Instead, Hubbard sees DSS as a business opportunity and a way for local stations to define themselves in the marketplace — once again — as *the* local service provider. Hubbard believes DSS provides local broadcasters with a way to leverage the power of local service providing news, weather and sports to the local market.

According to Robert Hubbard, USSB's

THE TALK OF THE TOWN

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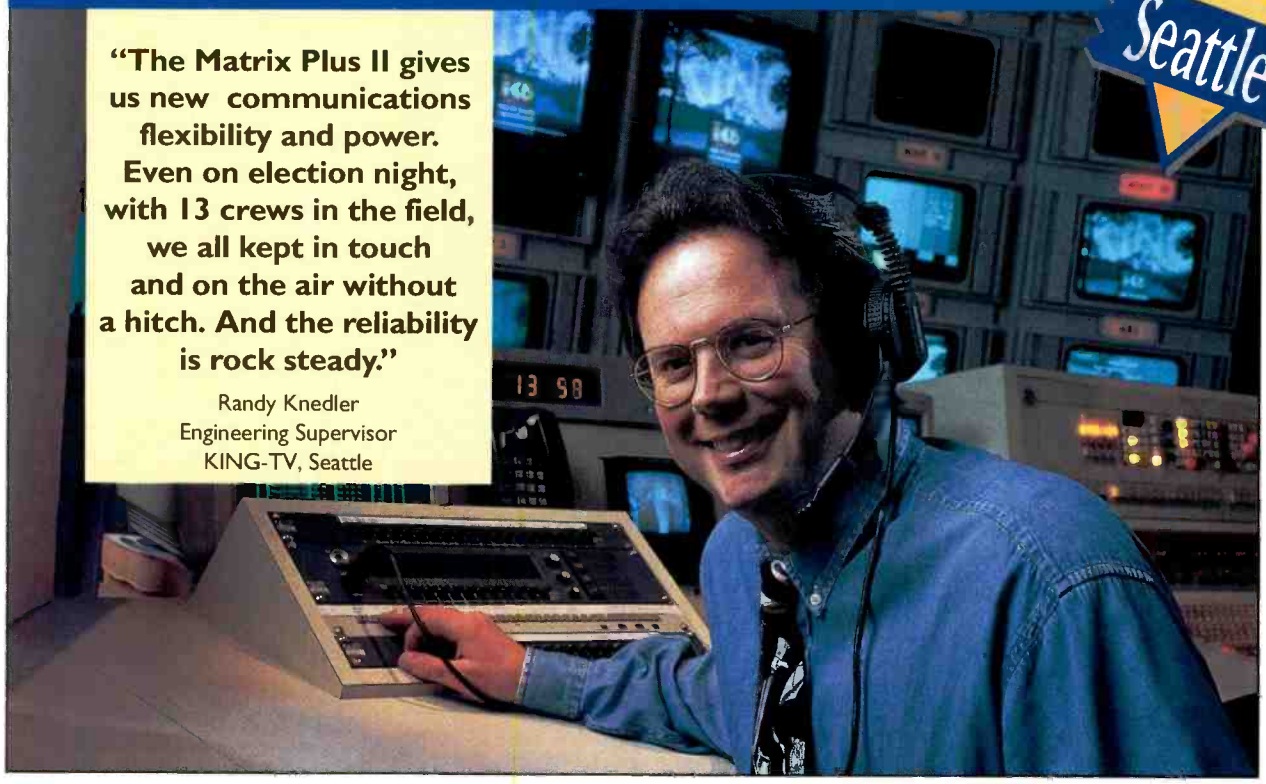

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Engineering Supervisor
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executive vice president, "We see DSS as an opportunity for local stations because it puts local stations back in control of their own distribution." As Hubbard points out, "Most people in the U.S. can get a better TV picture from an over-the-air television station than they can get from a cable system."

There's another benefit that USSB's executive vice president believes DSS delivers to broadcasters: "If people are watching their multichannel viewing from a national distribution system — CNN, ESPN from a national distributor [like USSB or DirecTV] — it means there is less competition for the local sales dollar. That is where TV stations today make the bulk of their revenues in most markets." Neither USSB nor DirecTV plans to sell local spots and local programming is out of the question.

Robert Hubbard summarizes what may very well be the eventual impact of DSS on cable and broadcasting: "It can be very important to TV stations if there is a significant shift in viewing from cable to national satellite delivery."

Consumers can set up their own DSS system in approximately two hours with a self-installation kit.

Stay tuned

DSS plans to make the transition from MPEG-1 to MPEG-2 compression imminently, while remaining compatible with existing home reception equipment. That change will not only lead to further picture improvements, but also increase channel capacity. DirecTV will be launching a third DSS satellite and adding 30 channels later this year.

Also in 1995, to keep one step ahead of Sony, Thomson will be introducing its second-generation DSS receiver. The new unit may add AC-3 audio, for example. With Sony joining the DSS arena, additional innovations are no doubt being planned. These may include combining a DSS receiver in a TV set, which Thomson has also mentioned. With new companies joining DSS manufacturing and marketing in 1996, the price of DSS home systems is likely to drop, just as it has historically for every major consumer electronics product.

The back of the receiver also presents a glimpse of the future of DSS. There, you'll find a low-speed data port, which Thomson has hinted it will tap for some type of data transmission service. There's also a wideband data port, which is designed to provide an upgrade to HDTV. Should DSS — as many observers predict — become the first source of HDTV broadcasts, DSS owners would be able to connect the port to an HDTV set or outboard decoder.

Stay tuned. ■

Marjorie Costello is a broadcast and video industry consultant and *Broadcast Engineering* contributing editor based in New York. Respond via the *BE* FAXback line at 913-967-1905 or via E-mail to be@intertec.com or by CompuServe at 74672,3124.

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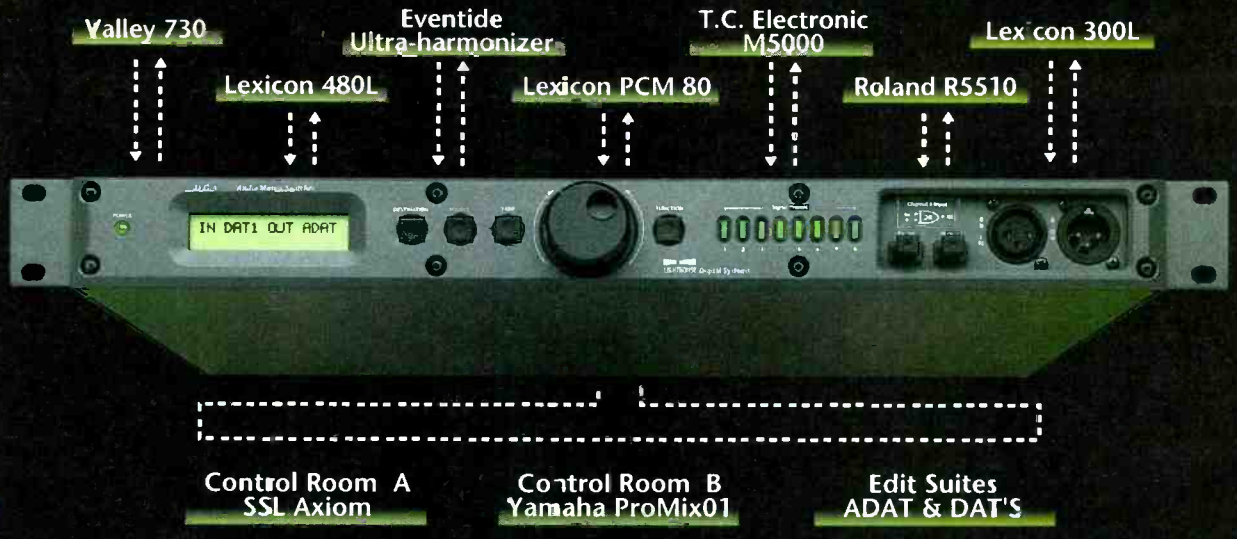

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Editing systems

Editing tools and processes have changed significantly over the last few years.

By Karen Mills

The Bottom Line:

In the beginning, it was the razor blade, then came cue tracks and finally time code. Today, random access storage and playback have added a new dimension to editing. In addition, software-controlled, computer-generated digital effects have allowed producers to turn almost any idea into reality. A powerful editing system can help a creative staff efficiently turn ideas into attention-getting spots and promos, increasing viewership and revenues. $

Editors, the people who edit for a living, are video storytellers. As creative teams expand to include additional people with diverse backgrounds, what role does the editing system play? As editing systems have evolved, they have provided us with a wide range of new tools. But are new tools necessarily better? Does today's editing system encompass the tools and features needed to get the job done quickly and efficiently? This article looks at today's editing technology, how it fits into today's workplace and some things to consider when tailoring a system to your needs.

Defining terms

Before getting too deep into the tools and technology, let's look at some of the many terms that have been applied to editing over the past few years. First, there's storage. In general, only two types are used, tape- and disk-based systems. Recently introduced tape formats have changed the game slightly, and now there are tape and disk recorders available in compressed (lossy and lossless) and non-compressed varieties.

Virtually all of today's non-linear editors are disk-based systems. Because of this, the terms disk-based and non-linear have been used interchangeably. Actually, non-linear refers to the process, not the equipment. Non-linear editing refers to the ability to assemble pieces in any order, including putting new pieces in the middle without covering up what is already there. Randomly accessed disk storage systems tout this "non-linear" capability. In reality, many of these systems never assemble anything but a playlist. New clips can be added to the playlist easily. Once complete, the playlist is executed and the result is transferred to a storage medium, usually videotape (because it's removable). In the linear editing process, the final product is assembled one piece at a time, usually from beginning to end. If changes are made in a section that has been assembled, the changes are either inserted over existing material or everything after the insert must be shuffled down the tape.

There is nothing to prevent a disk-based system from being a linear editor. Conversely, given a sufficient number of high-speed transports, a tape-based system could be used in a non-linear manner. However, these scenarios do not account for the individual strengths of these two mediums. High-speed random access is a major strength of disk drives, while high-capacity, low-cost removable storage is a strength of tape-

Photo: The network control room at Home and Garden TV, where video server and disk-based editing technology is used extensively. (Photo courtesy of A.F. Associates.)

based systems.

Another wrinkle is the so-called hybrid editing system. Is it a linear/non-linear hybrid or a tape/disk hybrid? One refers to the editing process, while the other looks at the storage media involved. Again, these terms are used interchangeably and can be easily misunderstood. The differences can be subtle, but the implications to the editing process may not be.

One other set of terms that should be defined is on-line vs. off-line. The final product of an off-line session is some form of edit decision list (EDL), whereas the final product of an on-line session is the actual production in its finished form.

Whether linear or non-linear, the graphical user interface (GUI) certainly offers far more information than the traditional text-only display of time-code numbers. (Photo courtesy of KTVK-TV, Phoenix.)

Leveling the playing field

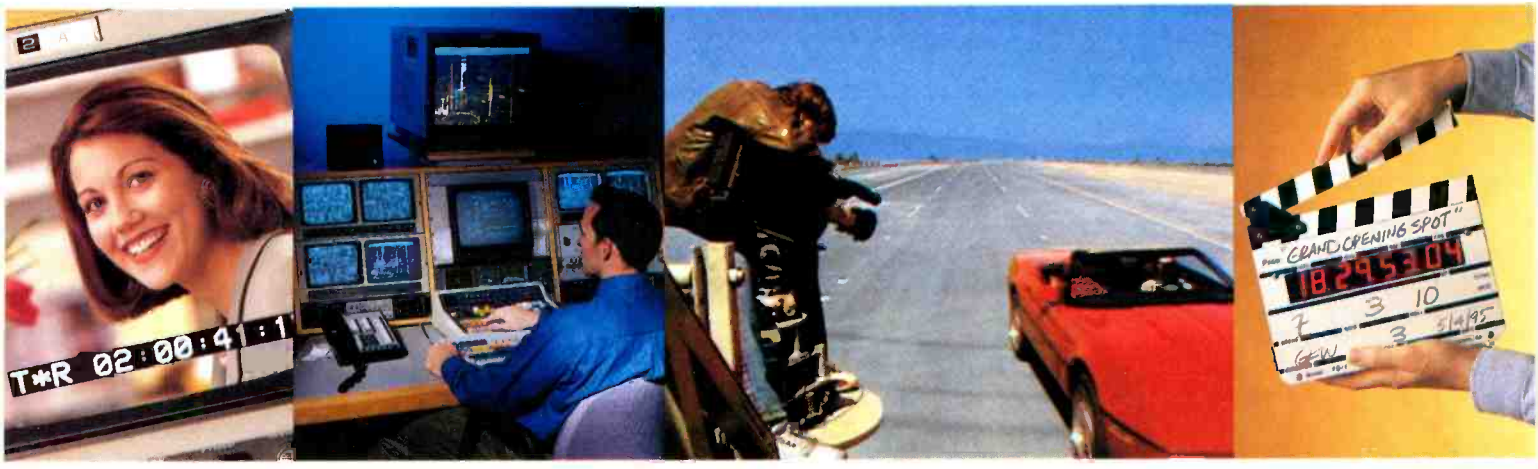
From a psychological standpoint, non-linear has, in some ways, leveled the playing field for the creative team. Random access editing allows possibilities to be explored quickly and easily. If the producer or client is experienced in non-linear's ability to handle rapid decision making, the editing process can move quickly. However, if those involved are unsure of exactly what they want or need, the process can get bogged down as an endless number of possibilities are tried and rejected. As always, it's the people and their expertise that make or break a project.

In stations, the non-linear process allows reporters and producers to instantaneously change things, experiment and create various aesthetic approaches while the technical logistics are suppressed. This can't be done in linear. Those editing in this scenario have the ability to give input early in the decision-making process. It's much like composing music, trying out different patterns of notes, meandering without commitment and checking out which sequences work together. The off-line process allows mapping of the pace and structure of the spot, but in the wrong hands, the process can be ineffective and time consuming.

Broadcast quality or grunge TV

Final picture quality is a variable that has allowed many of the desktop and lower-quality tape formats to prosper. The picture

There are a lot of great performers in films and videos.



(Many of them are Seagate A/V Professional drives.)

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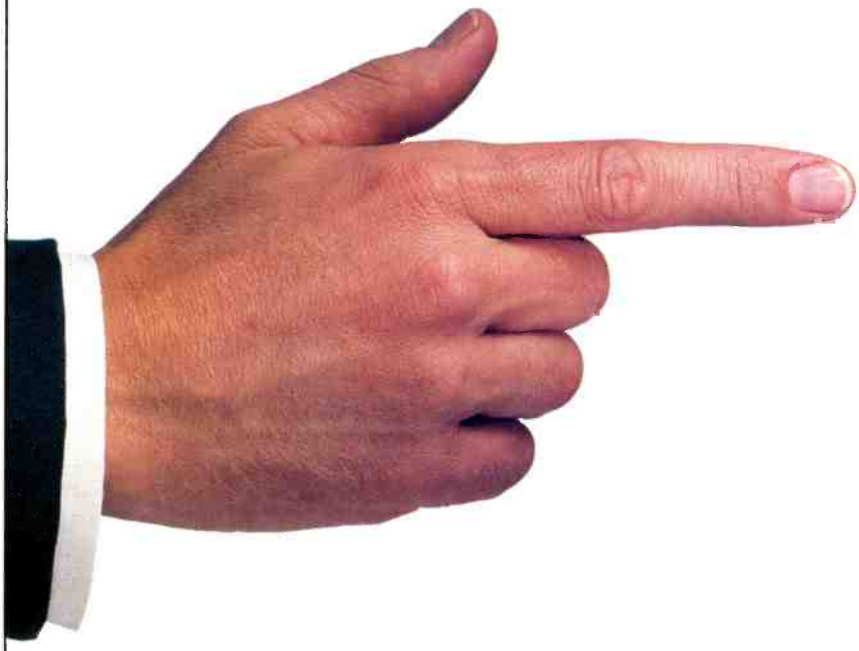

Years ago, a solution containing magnetic-sensitive particles was applied to 2-inch tape to determine where to "make the cut" with a razor blade. (Photo courtesy of Ampex.)

quality of a wedding video is not expected to exceed that of a national spot done for a major advertiser. Although, many times the reduced quality offered by some systems has been used as a creative effect. Today, for instance, monochrome is an effect; years ago it was state-of-the-art. Simply put, acceptable picture quality is subjective.

The trade-off in using some non-linear editing technology is that people will accept lower picture quality if it costs less. This is much the same reason why large numbers of U-matic machines were sold, despite the reduced signal quality when compared with 2-inch machines. Beyond this, people identify artifacts as a mistake; digital video noise is emotionally and psychologically unappealing. Much of the reason non-linear did not gain acceptance for on-line use was because of objectionable compression artifacts. Today, sophisticated algorithms provide much better image quality, making many of the disk-based systems usable for a wide range of on-air content.

Compression is here to stay. In many instances, the trade-off of a few pixels for additional storage is perfectly acceptable. It makes sense in workstations, video servers and, eventually, for many aspects of HDTV. How the compression components will all be integrated into a broadcast operation remains to be seen. Cascading compression systems can cause problems as successive decimations reduce the actual picture content. Algorithms, such as the proposed 4:2:2 MPEG studio profile at 18Mb/s, need to address broadcast requirements, such as chroma-keying, multiple generations and transcoding from one format to another. Once the signal is broadcast, MPEG-2 can be used to reduce the bandwidth even further, without concern about subsequent compression. However, this may change as home recording technology for HDTV becomes more commonplace.

Digitizing source material and rendering

Across the board, these are major problems for disk-based systems. Getting source material into the NLE environment takes time, often too much. Few, if any, of the disk-based systems are capable of digitizing faster than real time.

New products have been introduced that allow digital (NTSC) video to be converted to computer standards. One of these products converts the digital video stream to SCSI-2 and vice versa. Another provides an interface that takes a D-1 VTR's output directly into an SGI system. This same unit can be used in reverse to record digital data onto a D-1 cassette, providing high-speed data backup and a convenient method to move digital files across town or across the country. Unfortunately, only a small percentage of stations have D-1 capability. However, these same tools are extremely useful within the post-production community.

Another problem with the disk-based systems is rendering time. What's the use in having special effects, DVE capability and a grab bag of neat transitions if they cannot be viewed quickly? Fortunately, improvements in disk drives and processor speed have improved this situation considerably. Systems don't have to be real time. They simply need to be quick enough to finish the task before the operator is ready with the next one.

Non-linear off-line, on-line and near-line

Over the past few years, the non-linear process has revolutionized how people edit, manipulate and sculpt visual and audio presentations in the post-production world. However, in the broadcast arena, the acceptance has been much slower. As discussed, a major obstacle was the digitize-and-compress bottleneck. Because of the time involved, it did not support the quick turnaround demands of news programming. The recent introduction of portable disk-based storage systems (cameras/recorders) attempts to address this problem.

Traditional videotape editing, along with newer hybrid systems that combine tape-and disk-based systems are finding much better acceptance. Many stations are adopting hybrid technology as a bridge and making the jump into non-linear by buying one or two systems to determine the best way to integrate them into the operation. Many stations have found additional use for desktop systems, including expanded local production, which can increase revenues.

Non-linear editing tools have become mainstream in corporate video, post-production and ad agencies. However, there are key differences in how these tools are used in these applications. For instance, non-linear tends to be off-line in post-production and ad agencies. Corporate video facilities tend more toward using non-linear as an on-line system for videotape output, and off-line for interactive CD-ROM output. In post facilities, non-linear editing has typically been used as an off-line system, due to a lack of acceptance and, until recently, insufficient image quality.

Recent advances in storage technology have

brought multigigabit hard drives to market at reasonable prices. Laser disk technology has advanced as well, allowing for near-line storage of archive material in a space-efficient manner. Networking technology has evolved to the point where large files can be manipulated across the network without the rest of the network grinding to a halt.

Networking

To efficiently network, editing, graphics and audio workstations normally require some video compression for transporting video over local area networks (LANs) within the facility, as well as wide area networks (WANs) to access outside databases and for alternative distribution. Networking streaming video, however, requires a deterministic approach — that is, one that guarantees synchronized delivery of video and audio. Switching, latency and fidelity are three critical success factors when building a network. Video servers have technological barriers, such as maximum number of simultaneous inputs and outputs and data transfer speed. With many server solutions based on computer industry technology like Redundant Array of Inexpensive Disks (RAID), TV stations need to examine closely how various storage approaches can provide an uninterrupted stream of programming.

How can broadcasters make the most of storage technology developed for data-processing applications? The most important objective to a data-processing facility is data integrity. Whatever happens, not a single byte of data can be lost, even if it means slowing response time down by removing some clients, stopping the system for analysis and system rebuild. Missing or corrupted data in this scenario could lead to millions of dollars sent to the wrong account or a complete rerun of a 12-hour batch process.

Conversely, the TV environment cannot stand a single moment of lost transmission time, even if it means using dropout compensation to incorrectly replace the missing parts of an image. Interrupted flow means unrecoverable revenue loss and make-goods. TV transmission has always sacrificed data integrity for a continuous image.

Can RAID systems and other computer-type storage be used for storage to support editing? By all means, but redundancy and dependable transfer of materials to and from archival data tape are two must haves. The key will be managing the storage and network systems in a manner that is seamless to the editing process.

Conclusion

A viewpoint that was echoed over and over by editors is that in the final analysis, key performance differentiators among editing systems will be more and more in software, rather than with the underlying hardware, and that the human element is critical to a successful project. Eventually, it is possible that tape will be replaced with stations having one of each format player for bringing archival materials on-line in a server. Also, what these workstation "islands" connect to internally, as well as somewhere across the globe, will determine a station's viability as a broadcast service business.

Leveraging content as a competitive asset will provide stations with alternative revenue streams — maybe even before HDTV becomes mainstream. One thing is for sure, editing tools, equipment and systems are likely to evolve into systems that take advantage of a wide range of computer and networking technology. ■

Karen Mills is president of White Light Video, Springfield, PA. Respond via the *BE* FAXback line at 913-967-1905 or via E-mail to be@intertec.com or by CompuServe at 74672,3124.

For more information on editing systems, Circle (110) on Reply Card.

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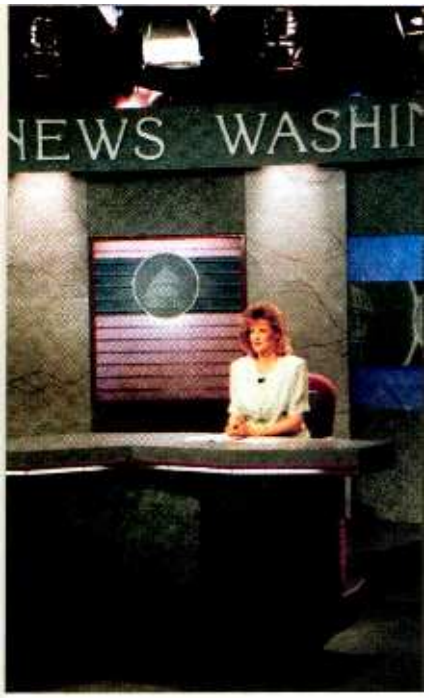
The changing newsroom

By the *BE* staff



Technological advances have changed almost every aspect of news gathering and production.

Recent events, including the Oklahoma City bombing and the Simpson trial in Los Angeles, have shown how TV news affects everyone. Viewers have come to expect virtually instant coverage of news events from anywhere in the world. The news coverage of the Gulf War brought daily events in the gulf into our living rooms. It permanently changed our perspectives on news and news coverage.

For stations and networks alike, the change in viewer attitudes has led to major operational changes. Those changes, along with others brought about by technological advances, have led to the development of newsrooms that function in ways that are radically different from just a few years ago. Remotes from nearly anywhere in the world are commonplace, even on local stations. Changes in storage and editing technology provide the ability to edit in the field, making it easier to get late-breaking stories on the air. Additionally, cellular phones and data communications allow stories to be sent from the field. Sometimes this process can be excruciatingly slow, but today it's possible. Desktop technology has allowed independent producers to build packages and syndicate them nationwide, allowing stations to cost effectively add outside perspectives to their newscasts.

This article looks at the changing newsroom by examining real world problems that have been solved by news and engineering departments. The first example looks at how a news operation took on the challenge of moving into a facility that was too small. The second example looks at how a San Diego news operation geared up to cover the Super Bowl after the Chargers won the AFC Championship. Neither of these articles are a how-to, but both provide numerous examples of solutions to real-world problems faced everyday by news and engineering departments.

The Bottom Line:

In a changing world, few things remain static. News operations face challenges daily. Many challenges are part of the news game — late-breaking stories, natural disasters and stories of heroism. Other challenges, such as integrating new technology and network affiliation changes, are unexpected but must be faced head-on. Overcoming these obstacles can improve the station's image and profitability. $

Constructing a facility in a limited space

By Jerry Foreman PBE

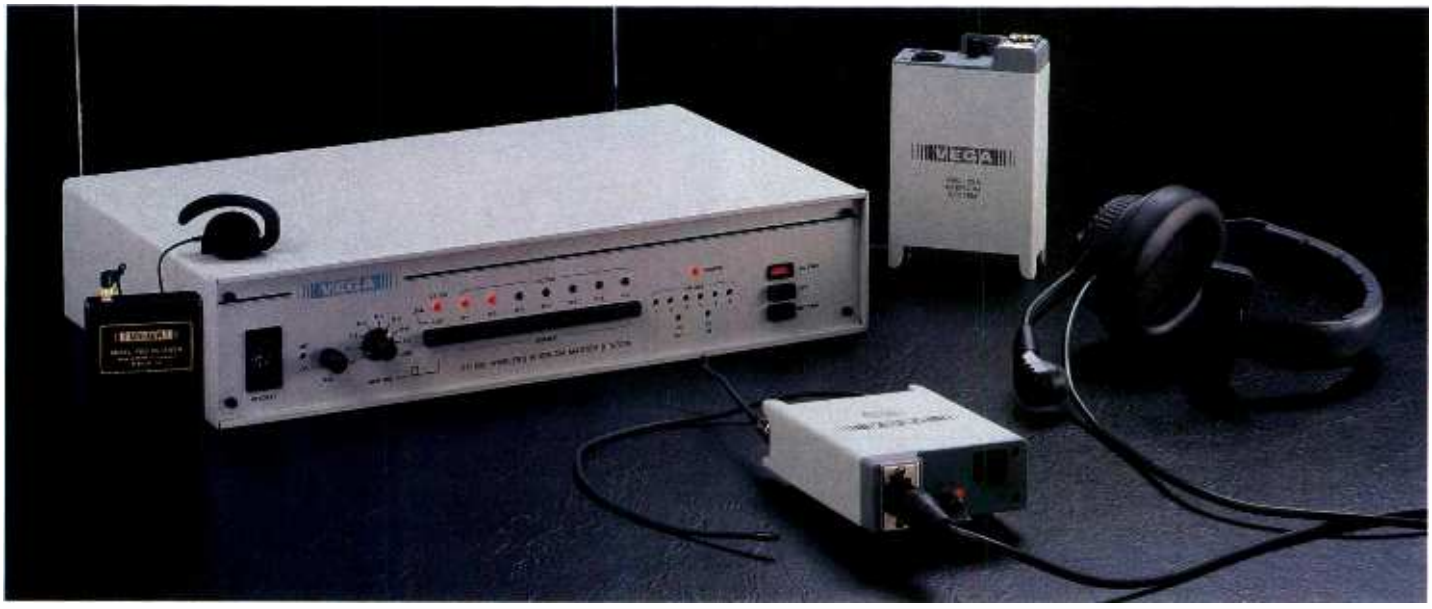
It's like building a remote truck that never moves.

Capital News is a 30-minute national and international newscast carried by independent TV stations and cable networks in a growing affiliation. It began as an outgrowth of an independent TV station in the Washington, DC, market. News operations shared the station's technical facilities and staff. However, about a year into the news operation, the station was sold.

The plans were to construct a new building for the news operation in Haymarket, VA, on a piece of property previously acquired for that purpose. Prior to settlement, however, the Walt Disney Company announced plans to construct a theme park within sight of the property. At this point, the planned construction had to be re-assessed to determine if the land had become too valuable and if sufficient room for expansion would be available if it became necessary.

In the meantime, it was decided that a temporary facility would be established to house the operation. By using floor space at the other end of the current building, some advantages were discovered, such as being able to continue using the same studio, set, lighting and the station's technical facilities. The section had been a technical area at one time, but had since been converted to office space. Adequate

Advanced wireless intercom system



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The Q600 system provides continuous, full-duplex, hands-off communications between up to six people plus an unlimited number of "listen-only" users.

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One QX-600 master station supports up to six QTR-600 remotes with "hands-free" two-way communications, and an unlimited number of PL-2 receivers for listen-only users. Circuitry is provided to interface external line audio with the system or to link two QX-600s into a 12-user system. The master station is directly compatible with all standard wired intercom systems such as Clear-Com, RTS, ROH, Telex, and many others via internal programming switches. A local headset position and extensive control, adjustment, and monitoring provisions are also included.

The PL-2 VHF mini-receiver provides a high-performance, low-cost solution to providing one-way "listen-only" communications. Very often, individuals need to receive instructions but are not required to speak. Using PL-2 receivers for this application avoids the expense of additional full two-way remotes and can significantly lower the cost of a typical system. The PL-2 is fully compatible with the Q600 system and is designed to provide reliable communications in the most demanding RF environments.

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power was available, but the floor space was limited and the air conditioning was deemed inadequate for the high concentration of technical equipment.

Physical layout

When asked if the equipment could fit into such a limited area, the reply was to treat the project as if it were a remote truck. The design criteria was to use every bit of available space while allowing for maximum ease of operation and maintenance.

Racks are used as room dividers, providing accessibility on both sides, as well as reducing dead space. The news operation is located on two floors, with most of the technical equipment on the second, while the first floor is shared between equipment and offices. The station's studio is being used for the permanent news set. The second floor consists of a 13'x8' room containing video control, the shop and terminal racks. (See Figure 1.) Next are two 6'x7' edit bays. Outside the edit bays are the producer's area and electronic parts storage, which has a large opening looking into the production control room (21'x11'). Adjacent to production control is the videotape room, and behind the VTR machines is the audio booth.

The first floor contains the combination satellite receiver-record room and writers' office. Another room contains an edit bay and computer terminal area. Additionally, on the first floor are the news director's, reporters' and producer's offices and a videotape storage room. Business offices for the news operation are located in another part of the building.

Because space is limited and the intended use of this facility is temporary, the station wanted to make the next move as easy as possible; that meant not attaching the equipment to the building. Efforts were made to avoid using conduit for cables and going under floors or above ceilings, which was accomplished with only a few exceptions.

The rack manufacturer was cooperative; equipment was fabricated to meet the station's needs at a reasonable cost. The wiring between adjacent racks was accomplished by placing the racks on a common base, while providing a 4-inch open area for cable runs. Racks in all areas are tied together with an aluminum cable tray system connected to the top of each rack. This allows cables to be run from one area to another easily and bonds the racks together electrically. Many of the racks are spaced four inches apart with a blank spacer between them. Mounted to the rear side of these spacers are two high-density power strips, which keep power wiring separate from the audio and video lines and power cords out of the way.

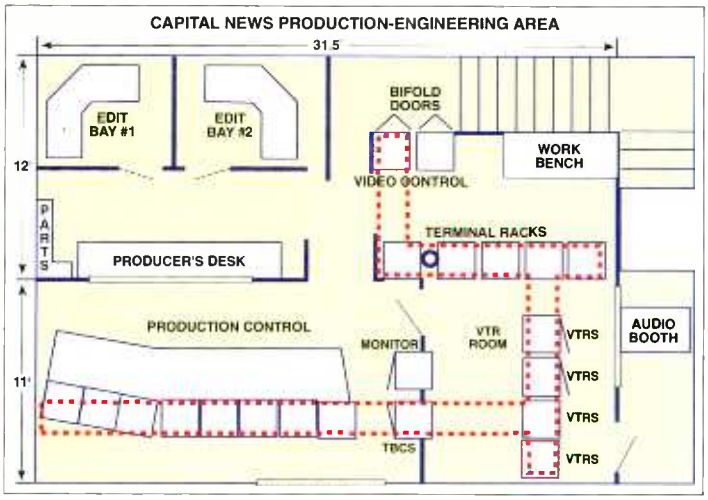

Figure 1. Floor plan of the second floor, showing how much equipment was placed within the limited space. Dotted lines indicate cable trays used to connect the racks.

In some instances, the racks are used as room dividers with doors on the rear of each rack for cosmetic purposes. The rack dividers are constructed with slits rather than holes for mounting, which allow for quick removal. Approximately 30 inches of space behind the racks and strip lighting make servicing easier.

One of the two second-floor edit bays. Computer stands were modified to hold the necessary equipment.

Because the racks in production control are mainly used to house monitors, this out-of-the-way area is also used for equipment storage. Some items that were not used after the move, but were too good to discard, are rack-mounted and stored here. Even though construction is industrial looking, efforts were made to make it as attractive as possible. The production console is constructed with a mauve countertop trimmed in cherry wood, and the rack fillers are metallic autumn red. The console can comfortably seat five people. However, keyboards for the still-store, editor, character generator and DVE can be moved to accommodate a small edit session. The upper portion of the monitor racks are tilted to reduce eye and neck fatigue.

The producer's area is immediately behind production control with the floor elevated 18 inches and a large opening in the wall that used to be a window. Because space is limited, walls in the producer's area have plastic parts containers mounted to them.

The two edit bays are small but adequate for one person, tight for two. Each has a cuts-only editor, Betacam SP recorder and player, 3/4-inch player, audio mixer, black-and-white and color monitors, good-quality audio monitoring and a house router station. The equipment is mounted on a computer workstation modified to meet the station's needs.

At the video control position, there are two racks housing the camera control units and monitoring equipment. The camera remote-control units and computer terminal are rack-mounted on slides to conserve space when not in use. A hole was cut into the wall behind the racks, and the rear of the racks are serviced from a hallway. Bi-fold louvered doors were placed in the wall at the rear of the racks covering the opening so that when the doors are closed, it looks like a closet. Next to the video control racks is an open space where a large mechanic's tool chest is located, and next to that is a workbench with shelves mounted above for test equipment storage. Opposite the video racks and workbench are the terminal racks containing audio and video distribution, routing switcher, program switcher, patching, sync system, quality control monitoring, audio delay units, electronics for DVE, CG and still-store. These racks act as room dividers, with the VTR room on the other side.

The VTR room consists of six racks, four containing VTR machines and the other two containing monitoring, TBC controls and editor electronics. There are 13 VTRs of various formats including 1-inch, 3/4-inch, Beta SP, S-VHS, VHS and laser disk. The decks are placed on pull-out shelves rather than rack mounts. The machine serial control lines go through a data switch selector, allowing machines to be routed to either of the ACE editors. The laser disk is used to assemble Capital News stories for playback, making it relatively easy to make last-minute changes to the lineup. Of course, a late story may be rolled in from a Beta VTR. Near the bottom of the VTR racks are tape storage compartments, another effort to conserve space that has turned out to be convenient. The back of the monitor racks are mounted

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The audio booth in a closet. Despite the small space, the room is flexible and comfortable.

in the wall between production and the VTR room. The rear of the VTR machine racks form a hallway leading to the audio booth.

The audio booth was a storage closet with a sloped ceiling. We fabricated an equipment bridge suspended from the ceiling. A reel-to-reel recorder, CD player, cassette recorder, digicart recorder, color monitor, intercom station, clock and a router control panel are mounted in. The console was limited to 24 inputs because of the limited width of the room. Four inputs on the console are fed from the router, giving access to all equipment in the house. The console sits on a pull-out, track-mounted tabletop, allowing for serviceability behind the equipment.

Electric power distribution consists of 20-amp circuit breakers, each supplying two racks. Every circuit has its own neutral wire (rather than sharing neutrals between circuits) and its own ground wire connected in a star configuration. A surge suppresser was installed at the electric panel. The wire-mold power strips plug into additional surge suppressers, which are plugged into regular electric outlets mounted to the cable tray system.

Capital News has operated in this facility for almost a year, and the station's "brick and mortar remote truck" has worked surprisingly well. ■

Jerry Foreman is director of engineering for Capital News, Manassas, VA. Respond via the *BE* FAXback line at 913-967-1905 or via E-mail to be@intertec.com or by CompuServe at 74672,3124.

Photos courtesy of Jerry Foreman.

Building a remote newsroom

By John D. Weigand

Getting it done practically overnight on a small budget can be a real challenge.

Excitement filled the air as the San Diego Chargers surprised many by becoming the AFC Division Champions. Almost immediately, the local TV stations began scrambling for a piece of the action. Along with the Chargers, KFMB-TV was on its way to the Super Bowl, leaving the engineering and news departments with the challenge of coordinating a remote news bureau. News had no budget for coverage of this type, so everything had to be carefully evaluated to maximize the coverage while minimizing costs. There were only two short weeks to assemble the entire package, coordinate the details and get the coverage on-air.

First steps

Frequency coordination was one of the first problems tackled by the engineering department. The first step was to ascertain which channels were used by the Miami-area broadcasters. This was simple and required only a quick check in the *Broadcasting Yearbook*. As a backup, the local frequency coordination chairperson was also contacted. The next step was to decide whether the remote would be sent home through satellite or fiber-optics. It was decided to use satellite transmission because it was far more flexible. The satellite news-gathering truck could be moved anywhere in town. Fiber-optics would have served only as a stationary service placed in a single location by telco and was more expensive than satellite transmission. If the station could stay within a single satellite service, through the CBS News Bureau, excess transponder time was cheaper than buying it on the open market. Because the networks offer this service to their affiliates, it is a wise move for affiliate stations to take advantage of the convenience.

Next, the station needed to obtain a satellite uplink truck. The truck needed editing

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Scott Weber, Buena Vista Sound, Walt Disney Studios

"The RE2000 has a crisp, clean and quiet response. I used less EQ to achieve what I look for. What goes in...comes out! It's also extremely versatile...from vocals to acoustic guitars to trumpets and violins."—
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"I think it's one of the most versatile I've ever used."— Roy Thomas Baker, Producer

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capabilities with 2-machine editing, a switcher, an audio board, an intercom and an interrupt foldback (IFB) system with three cell phones. A truck was located that came with a full-time uplink engineer, was fully redundant and had a 4-port combiner, allowing for dual uplinking on either polarity. However, it lacked the audio capabilities needed. Rather than renting an audio board locally, the station sent one from San Diego. Although packaging and sending it was an inconvenience, the cost savings outweighed any difficulties.

Super Bowl coverage involves many crews working together, miles of cable and numerous cameras throughout the stadium. (Courtesy of AP/Wide World Photo.)

Local coverage complicated things

For added coverage, news sent a reporter to San Francisco to the opposing team's hometown. To complicate matters further, news was also running a remote from Los Angeles to cover the O.J. Simpson trial. Everything was done live and sent to the home studios by satellite uplink. Feeds had to be carefully coordinated to avoid interfering with regularly scheduled satellite feeds.

When it was all up and running, our San Francisco reporter talked to the Miami reporters and the studio anchors on a 3-way communication through the IFB system.

Setup in Miami

One maintenance technician was sent to Miami along with seven camera persons, two producers, a newsroom editor and talent that were rotated in and out. An additional reporter went on the road, reporting human interest pieces from small towns on his way to the Super Bowl. These stories were sent back by satellite feed and were normally recorded and played back during the regularly scheduled newscasts. However, the newscaster was not precluded from sending back a live feed on a hot story should one occur.

Working across three time zones, the feed for the six o'clock news originated live in Miami at 9 p.m. along with a 2 a.m. feed for the 11 p.m. newscast. Because of this, the remote broadcast location had to be carefully chosen so it would not disturb anyone in the area.

The site chosen for the remote newsroom was outdoors, with the inland waterway as a backdrop. In Miami, a local lighting company provided the lighting equipment because sending the station's lights to Miami would have been a nightmare. The location chosen was on the balcony of the California Cafe, located in the Hyatt Regency Hotel. The Hyatt was the hotel used by the Chargers as well as the station's crew, making the location convenient for all concerned. It was also thought to be a fairly safe location and a good choice from the lack of disturbance standpoint.

Everything went fine with one minor exception. The weekend toll bridge operator contacted the Coast Guard and complained that the lights used for the newscasts prevented him from properly running the toll bridge. The lights were reoriented so that they would not disturb him.

Two hotel rooms were set up as edit rooms since the editing capabilities of the rented truck were limited. In fact, the truck's editing capabilities were lost once the remote went live, something we learned to avoid the next time. In all, two Beta machines and a monitor for each of the three edit rooms were shipped to Miami.

As part of his duties, our maintenance technician was required to oversee the early morning setup. He set up the microphones and the audio board, and during the live portions of the broadcast, he served as floor manager and ran the audio board. Each night all the equipment was packed and locked in the truck or moved into the California Cafe. In addition, he was expected to maintain the equipment, from the field cameras to the edit rooms. To help with all this,

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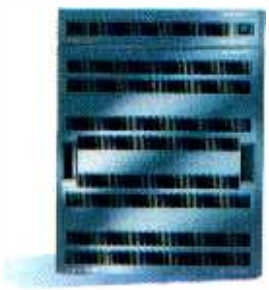

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the appropriate tools, along with cash for parts, were sent to Miami.

In getting data to and from the remote site, it was found that the computers created some problems because the newsroom computers locked up too frequently. However, the fax and cellular phones worked well. A rundown sheet was prepared and faxed daily to help coordinate the live feeds with the regularly scheduled newscasts. For cell phones, KFMB-TV negotiated with a local supplier for phones to take to Miami. A special rate was negotiated using ROAM service, which was less than renting the phones in Miami.

In getting the remote feeds on the air, including the remote newscasts from Miami, it was necessary for crews to wear many different hats and work long hours. The news photographers also took on different tasks, helping with audio, running on-air cameras and serving in whatever manner they could. Back in San Diego, engineering put in plenty of extra hours getting ready for yet another home remote — a welcome home parade for the Chargers.

Back on the home front

In the studios in San Diego, the existing IFB system was insufficient to get the job done, so additional units were rented. The audio board was reconfigured so that submixers B, C and D fed out as separate mix minuses into the IFB system, which was tied to phone couplers for the remote feeds in Miami, San Francisco and/or Los Angeles. A rented framestore/synchronizer was assigned through a video patch-bay to the Miami remote. Existing framestores were used for the satellite feeds on an as-needed basis. To address lip-sync problems, an audio frame synchronizer was put into service and made available to the audio operator in San Diego.

The ENG van covered the return of the Chargers at the airport and microwaved the feed back to the studios. This signal went to a rotatable antenna at the station's transmitter site. Unfortunately, a week prior to the broadcast, it was discovered that the antenna was inoperable. Thankfully, Broadcast Microwave Services, Inc., a local manufacturer of antennas and receivers, offered the station a loaner. The antenna was quickly put into service, and the remote proceeded without incident. A second van was placed at the parade staging area, and it was used to cover various interviews of the Chargers and staff, which were also microwaved back to the KFMB-TV studios.

Half of the news crew and a major complement of equipment was still in Miami when the time came for the welcome home parade. Because of this, a 5-camera remote truck was rented. One camera was posted on a cherry picker overlooking the parade, one was roving in the crowd and the others were used to shoot the news talent on the reviewing platform, as well as the parade. We provided the camera people, and the rental company provided the audio and video operator as well as setting up and tearing down the remote.

The local telco was contacted to get the parade feed back to the studios. Telco provided a combination of fiber-optics and microwave. Because the telco was unable to provide a fiber-optic drop where it was needed, the signal was microwaved to a drop site and went on fiber the rest of the way.

Meanwhile, in San Francisco, a reporter was covering the fans' reaction to the Forty-Niners' victory. This provided another microwave feed into the KFMB-TV studios.

After it was over, it was time for debriefing and discussions regarding potential areas of improvement. San Diego is readying itself for the '96 Republican National Convention and will host the Super Bowl in 1998. Frequency coordination will be a top priority for these events as numerous crews descend upon San Diego. Having this recent experience, the station was able to evaluate its current capabilities and will be well prepared for these upcoming events. ■

John D. Weigand is director of engineering for KFMB-TV, San Diego, and the SBE frequency coordination chairperson for San Diego County. Respond via the *BE* FAXback line at 913-967-1905 or via E-mail to be@intertec.com or by CompuServe at 74672,3124.

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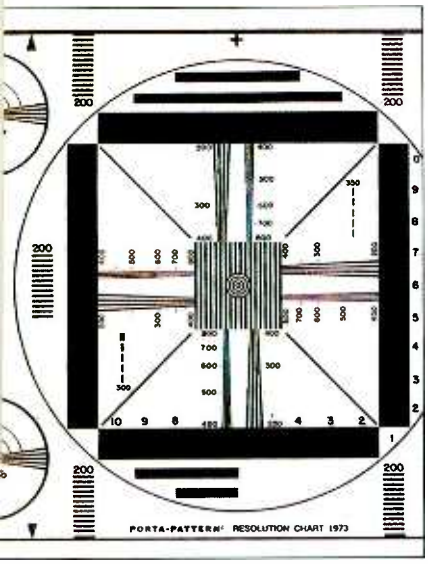
Evaluating low-light camera performance

By Robert H. Eather



Specifications reveal little about actual performance unless they are properly defined.

The Bottom Line:

Looking at camera specifications used to reveal a lot about a camera's performance. However, nearly all of today's camera specs look the same. Even cameras designed for the consumer markets tout specs that rival professional models. Knowing what to look for, or, maybe more appropriately, recognizing what's missing, can provide considerable insight into the "specsmanship" used by manufacturers. $

There is no industry-accepted quantitative definition of minimum illumination. Nevertheless, the minimum illumination for many cameras is highlighted in advertising. Numbers such as 2 lux are specified, often accompanied by statements such as "takes pictures in almost total darkness." This practice pervades markets from consumer through the industrial to the professional, with consumer camera specifications taking the greatest liberty in stretching any reasonable definition of minimum illumination. This article looks at low-light performance and color reproduction of 3-CCD cameras used for professional video applications.

Knowns and unknowns

Qualitatively, minimum illumination is defined as the scene illuminance measured in lux that is required to give out a certain IRE level at standard TV frame rates. This is done at maximum camera gain and maximum lens aperture. Maximum lens aperture is the smallest f-stop, typically f/1.4 for ½-inch cameras and f/1.7 for ⅔-inch cameras. Rarely specified, but reasonably assumed, is a scene reflectance of 89.9%, color temperature = 3,200°K, gamma on (= 0.45) and auto knee off. Until recently, maximum camera gain was typically 18dB, but higher electronic gains (24dB and 30dB) are becoming more common.

The large unknown is the output IRE level used to specify minimum illumination. This level varies between manufacturers and varies for a given manufacturer between its broadcast, professional, industrial and consumer divisions. (See Table 1.) Posing the question to its engineering departments leads to evasive or uncertain replies. The numbers quoted can depend on who you talk to. The dividing line between EFP, ENG and high-end industrial cameras can be fuzzy, so accuracy is not guaranteed. The last column in Table 1 gives the factor by which the quoted minimum illumination should be multiplied to standardize to 100IRE output (auto knee off).

Minimum illumination claims can be rapidly inflated by reducing the required IRE out. This is because of the shape of the camera gain or gamma curve. Although most cameras quote a gamma of 0.45, the theoretical curve (see Figure 1) may not be followed exactly. Black compression may be used to reduce noise at low light inputs. This can also upset color balance. (For more information, see "CCD Camera Technology," *Broadcast Engineering*, July 1993.) Auto knee circuits are used to compress dynamic range at high light inputs. Gamma is sometimes decreased to ~0.35 in high gain settings to give increased gain at low IRE values. Figure 1 also shows a measured response for a current model ENG camera at 18dB gain (auto knee off) where it may be seen that some black compression has been implemented. Examination of the gamma curve shows that if 7.5 lux is required to give 100IRE out, then only 1.5 lux would be required to give ~50IRE. Thus, a camera specified to have a minimum illumination of 1.5 lux at 50IRE out is no more sensitive than a camera quoted at 7.5 lux for 100IRE out.

The most sensible way to define a minimum illumination specification is to require a specified IRE out at some level below where auto knee switches in (e.g. 70IRE) and to quote the associated signal to noise (S/N). The lesson here is that minimum illumination specifications should be ignored unless IRE out is specified. In fact, the camera's sensitivity specification is far more meaningful, because it allows you to quickly calculate the lux required to give 100IRE out at maximum gain and maximum lens aperture.

Sensitivity is normally defined as the lens f-stop

Continued on page 51

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Continued from page 48

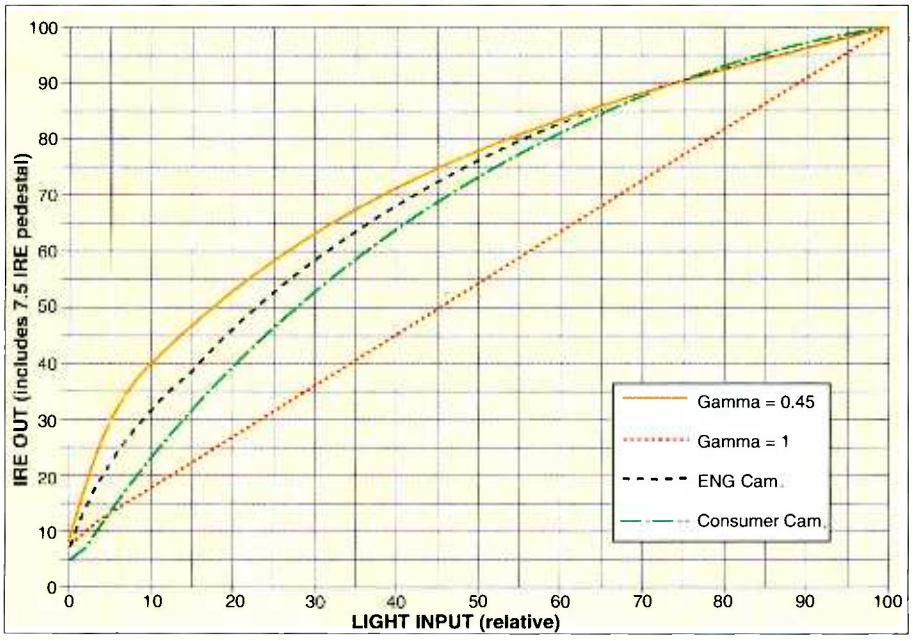

Figure 1. Gamma curves used in today's video cameras. Note: the light input is relative and not absolute.

required to give 100IRE out for 2,000 lux scene illumination. This is done with 0dB gain, 89.9% reflectance, color temperature = 3,200°K, gamma on, black compression (if applicable) off and auto knee off. For example, if a camera with an f/1.4 lens and +18dB maximum gain has a quoted sensitivity of f/8.0/2,000 lux (0dB), this is equivalent to f/1.4/62.5 lux (0dB) or to f/1.4/7.8 lux (+18dB). The 2,000 lux standard is decreased by a factor of two for each f-stop decrease and a factor of two for every 6dB increase of electronic gain. Therefore, 7.8 lux is the camera's minimum illumination for 100IRE out or 3.2 lux for 70IRE out (based on a gamma of .45).

Higher electronic gains (24dB and 30dB) decrease minimum illumination but increase noise. Even though gains above 18dB may give objectionably noisy pictures in some applications, it is certainly desirable to have this capability. Integration techniques decrease the minimum illumination required while actually increasing S/N. The integration may be spatial or temporal. For example, horizontal binning of two pixels can give a 6dB (factor of 2) gain in sensitivity at low light levels. The additional sensitivity is achieved at the cost of decreased horizontal resolution, not only because of the binning, but also because the spatial offset technique for increasing resolution is defeated. Time integration is also possible, and some industrial and consumer cameras have the ability to integrate on the chip to increase sensitivity at low light levels. This increased sensitivity is achieved at the cost of decreased temporal resolution. Both of these techniques can be combined, but currently this is only implemented on scientific cameras. Future DSP camera design has the potential to make this dual integration technique available for professional cameras.

Electronic noise

So far, we have neglected the question of noise. The quality of the video pictures at low light levels depends on the associated noise. A noise figure should also be quoted with any useful minimum illumination specification. We can start to estimate noise from the S/N specification for the camera. This is defined as full video output (100IRE) divided by the root mean square (rms) noise at 0dB gain with the lens capped. You have to be careful with this specification because it can be misleading. It is not usually stated that the noise is measured with gamma off, bandwidth reduced to ~4.2MHz ("weighted bandwidth" approximating the aperture response of the human eye) and sometimes with a reduced pedestal level (5IRE instead of 7.5IRE). Figure 1 shows that small IRE levels typical of noise are reduced by a factor of about two to five when gamma is off (=1). Thus, if a 3-CCD camera is specified as having S/N = 60dB (0dB gain), this is equivalent to 42dB (18dB gain) with gamma off and ~36dB with gamma on (which it always is for normal camera operation). If the camera has a +24dB gain position, then S/N levels would be reduced an additional 6dB. Because of lower sensitivity and less-sophisticated electronic circuitry, single-CCD cameras have S/N figures of 45 to 50dB (0dB gain) or 24dB (18dB gain, gamma on). These figures illustrate the deviousness of specifications that define noise with gamma off and reduced bandwidth to derive an S/N figure.

In reality, actual noise is less than this simple conversion above would indicate due to noise-reduction techniques implemented at high

SPECIFIED IRE OUT AT MINIMUM ILLUMINATION LEVEL					
Manufacturer:	Sony	JVC	Panasonic	Hitachi	x Correction for 100IRE Out
Studio broadcast, Professional EFP and high-end ENG cameras:	100	100	100	100	N/A
EFP/ENG ≤ $10K, and high-end industrial cameras (3CCD):	50	100	70	50	5, 1, 2.5, 5
Industrial cameras single CCD:	50	35	30	30	5, ~10, ~10, ~10
Consumer camcorders (estimated):	~20-25	~20-25	~20-25	~20-25	~20

Table 1. When specifying minimum illumination level, many times manufacturers don't tell the whole story. The table illustrates one method (reduced output) used to exaggerate cameras' low-light level performance.

gain and low IRE levels. Black compression reduces gain in the low IRE output region and also reduces noise. Hard black clips can reduce noise 50% at low IRE by clipping the black level. Bandwidth is almost always reduced when the camera is at high gain, reducing noise at the expense of resolution. Recent DSP cameras have introduced digital noise-reduction techniques that work by either comparing and differencing consecutive video fields, thus introducing a lag effect or by performing adjacent pixel comparisons within a single video field, causing some decrease in resolution. The degree of implementation of such techniques is never specified quantitatively, making it impossible to use published specifications to decide the lowest light level that will give an acceptable picture. Also, acceptable pictures are actually based on an individual value judgment and always depend on the application.

One other comment on noise is in order: rms noise is specified, but a better measure is peak-to-peak noise, which by definition is some six times the rms noise level. What peak-to-peak noise level might be expected from a typical camera operating near its minimum illumination level? The above example at 18dB gain gives an S/N of 42dB with gamma off, translating to a noise amplitude of 0.8IRE rms (100/2^7) or 5IRE peak-to-peak. Actual noise amplitude with gamma on will be higher, and the final value depends on the implementation of noise-reduction techniques.

Photon noise

The discussion of noise has only considered electronic noise sources. This is primarily readout noise and its amplitude is a function of the quality of the CCD and the quality of the camera electronics. At extremely low light levels, photon noise (or "shot" noise) also becomes a factor. This is simply statistical noise in the (small) number of electrons generated per pixel. If the number of electrons generated in a CCD pixel in a TV frame time is N, then the photon noise is $\sqrt{N}$, making the S/N, $N/\sqrt{N} = \sqrt{N}$. The calculation is somewhat complex, but take for example 3 lux at f/1.4 and a typical ½-inch CCD. At normal TV frame rates, the rms photon S/N will be about 33dB. The actual noise amplitude depends on the camera output from 3 lux. For example, for a camera giving 100IRE for 7.5 lux at f/1.4 with 18dB gain, 3 lux gives 37IRE output (above pedestal) with gamma off. The rms photon noise at 33dB S/N would be 0.8IRE rms (37/$2^{5.5}$), or 5IRE peak-to-peak, which is the same level as the electronic noise discussed above. In fact, for this example, photon noise begins to exceed electronic noise at all f-stops and camera gains for IRE output levels of ~37IRE (gamma off) or ~60IRE (gamma on) and limits the real S/N of the video signal near full output to ~47dB.

Integration techniques used to increase sensitivity (spatial binning and/or time integration) also increase S/N. Pixel binning combines signal and random noise from two pixels, and time integration combines signal and random noise from two fields. Either technique will give an output signal of 2N (an extra 6dB) with the associated noise level ($\sqrt{2N}$) increased by only 3dB, thus S/N increases by 3dB.

This is exactly what is claimed by JVC for its pixel-binning LoLux mode. Panasonic's Super High Gain and Night-Eye modes are similar.

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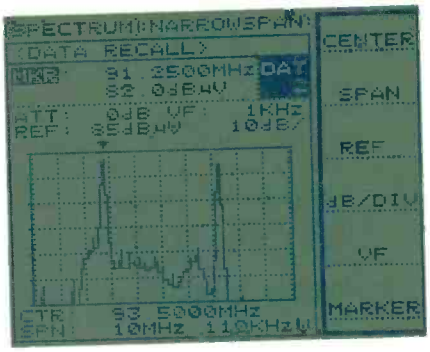

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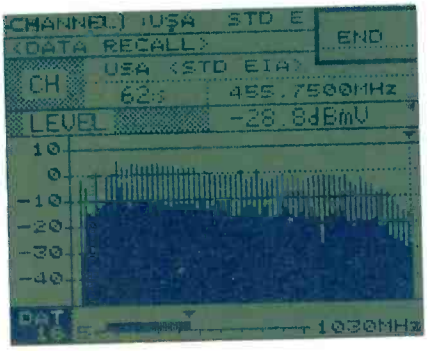

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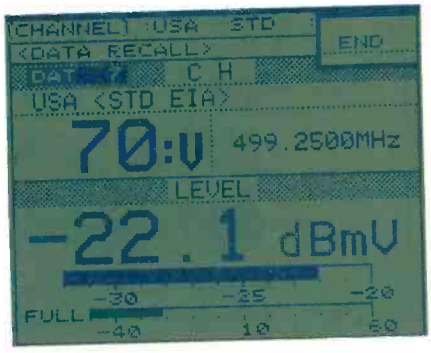

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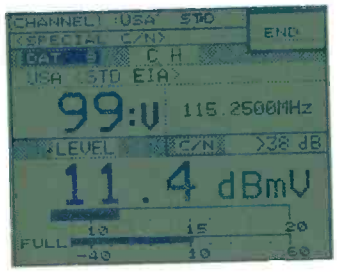

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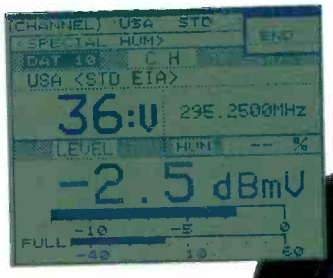

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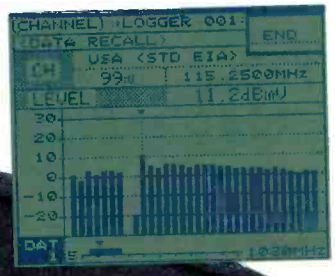

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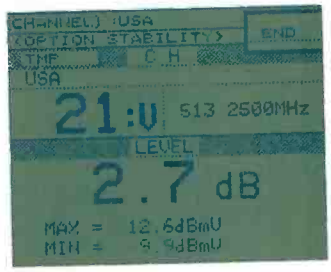

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separator, making it less desirable.

- Even though the pixel area on 2/3-inch CCDs is double that of 1/2-inch CCDs (which in turn has double the area of 1/3-inch CCDs), the S/N performance is not significantly different. Driven by the large consumer market, 1/2-inch CCDs have been developed to a higher degree of sophistication. Currently, 1/2-inch CCDs have less relative area taken up by shift registers, transfer gates, control lines and channel stops. This results in a larger percentage of the pixel area being light sensitive.
- The technique of back thinning, which increases quantum efficiency by a factor of two to three in the visible region, is only implemented on expensive scientific CCDs. Expense aside, this technique offers the best possibility of significant improvement in the low-light capability of professional CCD cameras.
- "Dark" or thermal noise and fixed pattern noise is usually unimportant at video frame rates at normal temperatures, but can be reduced by cooling the CCD(s). Such cooling is seen in some broadcast studio cameras and is common in scientific devices.

Just how accurate are quoted minimum illumination figures for professional CCD cameras? Using a carefully calibrated standard light source, we tested five current-model

Continued on page 72

The Plumbicon tube

In the early days of television, all cameras relied on tube technology for image pickup. They were typically equipped with image iconoscopes, image orthicons or vidicons as the pickup tube devices. Unfortunately, the iconoscopes and orthicons were large and cumbersome. They also had low sensitivity and therefore required a tremendous amount of studio lighting. Their use for color television was almost impossible. The vidicon had other shortcomings — nonlinear response, a long lag time and a tendency to retain images.

An early solution to these problems was the Plumbicon camera tube developed by Philips. Because of its similarity to vidicon tubes, it is also known as a *lead-oxide vidicon*. The Plumbicon was first used in the late 1950s.

How do they work?

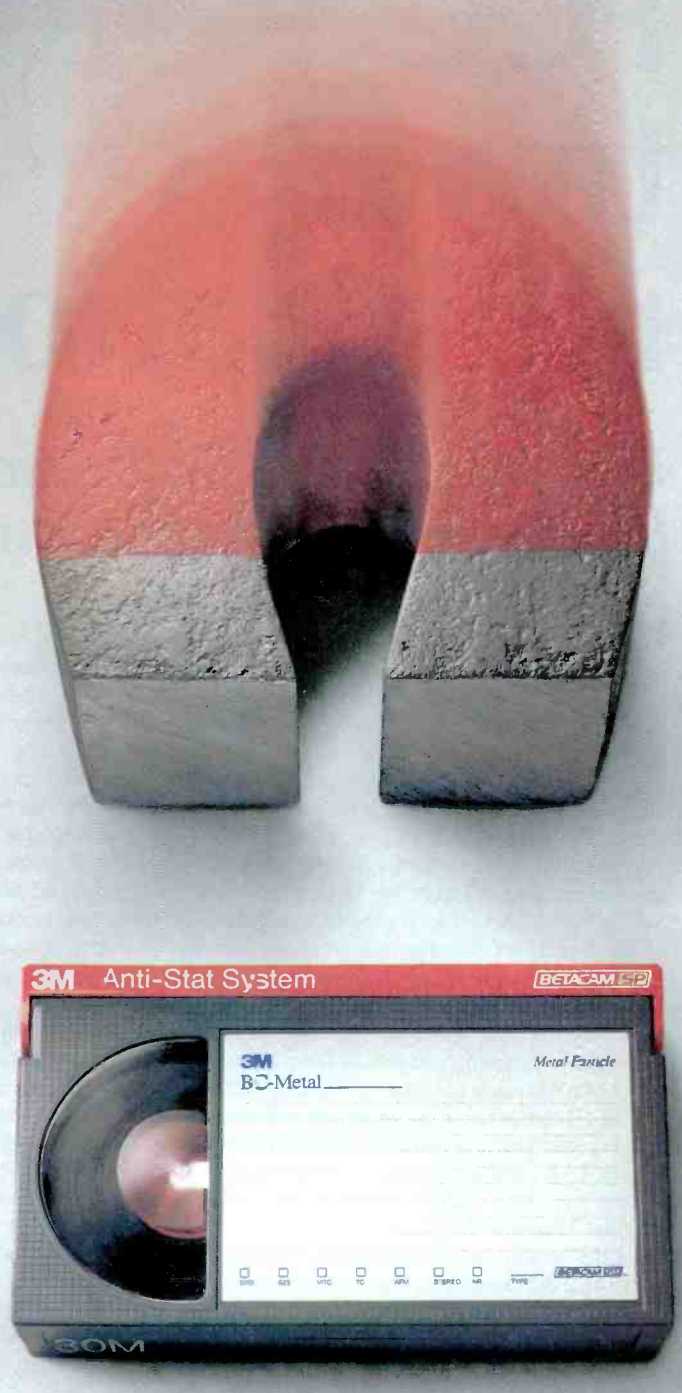
The image is focused on the tube's glass faceplate, which has a coating of conducting oxide such as Sn0. The lead oxide, although continuous, consists of a portion that is p-type, a region of intrinsic PbO, and a layer of n-type lead oxide. The unit acts as a reversed bias p-i-n junction. The design limits any leakage or noise current (dark current). An additional benefit is that the tube is also relatively insensitive to temperature fluctuations.

The lead oxide layer consists of randomly oriented micro-single-crystals creating a large effective surface area, which increases the tube's sensitivity. Because lead oxide is a photoconductor, electron-hole pairs are generated in proportion to the amount of incident light. As the electron beam is scanned across the faceplate, an analog signal representing the electrical equivalent of the optical image can be extracted.

Many stations still rely on tube technology in their studio cameras. For some, it may be preferable to consider the advantages of replacing camera tubes rather than having to buy new cameras.

Tube cameras produce excellent images and are currently capable of producing more than 2,400-line resolution. Additional improvements include good highlight handling, large signal-to-noise ratio, and low output capacitance. Thus, the Plumbicon is well-suited for use in HDTV applications. Be sure you consider all the options when looking at new studio cameras. ■

Acknowledgment: Material provided by Philips Components, Slatersville, RI.



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FCC tower registration

By Robert D. Greenberg

Big changes are in the works for broadcast tower regulation.

The Bottom Line:

The FCC has proposed new rules that will simplify and otherwise affect the regulation of broadcast towers. This new process should save the commission and the industry significant time and money. The author of this article originally suggested these changes to the commission, and he then led the team that developed the proposed new regulations. $

On Jan. 12, 1995, the FCC adopted a Notice of Proposed Rulemaking (NPRM), WT Docket No. 95-5, which proposes to streamline the commission's antenna-structure clearance process. The proposed process will replace the current clearance procedures (which apply to all licensees and permittees) with a uniform registration process for all tower *owners*.

As part of this proceeding and in keeping with updated recommendations by the Federal Aviation Administration (FAA), the FCC proposes to revise Part 17 of its rules titled "Construction, Marking and Lighting of Antenna Structures." The commission further proposes to revise applicable sections of its rules, making antenna structure owners primarily responsible for the maintenance of obstruction marking and lighting (OML). The FCC believes that these proposals will simplify and expedite the processing of authorizations involving FAA coordination. It is anticipated that a Report and Order (R&O) on this matter will be adopted sometime this year.

For this article, the terms *antenna structure* and *tower* are interchangeable. These terms refer to any structure that is an antenna or has an antenna mounted on it and is subject to FCC rules.

The tower standardization concept

In processing thousands of applications over the years, it became obvious to the FCC staff that there were parts of the processing system in need of improvement. For example, it was inefficient to have so many different forms and procedures, depending on which service and bureau you were dealing with, for getting a tower approved by the FCC. The regulation of a tower structure should be essentially the same whether there is a broadcast antenna or a cellular antenna on it.

Another unnecessary bureaucratic complication involved towers with multiple users — which applies to the vast majority of towers. If a tower owner wants to increase the height of a multi-use tower, all broadcast licensees on the tower must file construction permits and license applications to reflect the increased height of the tower even though there is no change to their transmitting facilities. (See 47 CFR Section 73.1690(b)(1) titled "Modification of Transmission Systems.")

In 1992, a call came from the FCC's chairman for ideas on streamlining operations. The idea of tower standardization was proposed, and shortly thereafter, it was approved for action. An 8-member team was assembled for the project comprised of staff from the commission's Private Radio, Common Carrier, Field Operations and Mass Media Bureaus. The team's members had more than 153 years of FCC experience. They were selected because they knew the processes and systems involved and would be willing to identify pieces of the puzzle that could be improved.

Objectives and opportunities

The tower standardization project is only one of many self-improvement processes that the FCC has undertaken. These team-based projects all use similar problem-solving techniques with the following goals:

1. Find permanent solutions to problems rather than "band-aid" fixes;
2. Build quality into FCC processes; and
3. Improve customer service.

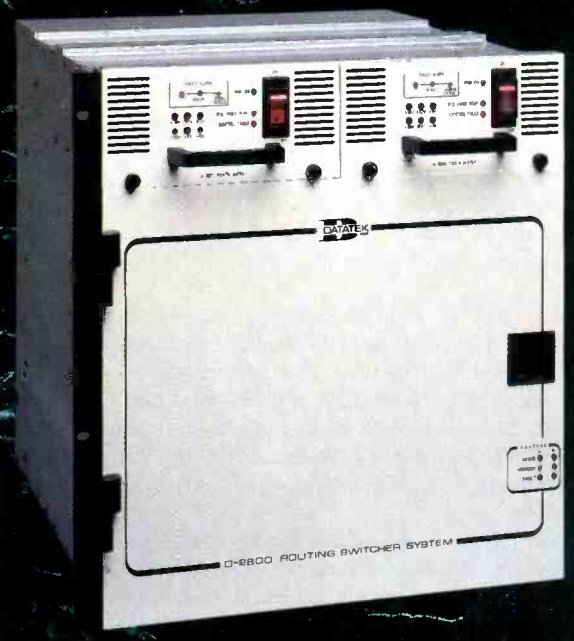
The first step of the problem-solving process is to create an *opportunity statement*. This statement focuses the team on a specific goal by describing exactly what results a given process is currently producing and what more desirable results it could be producing.

With respect to improving the antenna-clearance procedures, the team developed this opportunity statement: "Reduce the additional time to process requests for changes in coordinates, height and OML involving existing antenna structures from 32 to 10 days."

Magnitude of requests

It is important to note the number of requests that the commission receives. These requests are applications and notifications. For instance, in the Mass Media Bureau, changes in tower coordinates or height require an application, while a change in OML requires a notification. In either case, an authorization should be issued.

In 1993, the Mass Media Bureau received 3,468 such applications and 540 notifications. In the Common Carrier Bureau, there were 1,404 applications,



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while in the Private Radio Bureau, there were 11,496 applications. The Field Operations Bureau conducted 1,296 investigations involving existing antenna structures during 1993.

The cost of poor quality

Because of the proliferation of antenna structures in the United States in the last 10 years, methods and procedures at the FCC that were once workable have become inefficient and cumbersome. One of the textbook definitions of the *cost of poor quality* (COPQ) is that it can cause a significant drain on resources and can have a strong negative impact on how customers view the services or products of the organization. The COPQ can also demonstrate the potential for savings or redirection of effort to more productive tasks.

The team assessed the COPQ involving its four bureaus. This cost was calculated at the rate of one worker-hour per request, multiplied by the number of requests, multiplied by the average salary of the worker. In the Field Operations Bureau (now known as the Compliance and Information Bureau), the cost was calculated at the rate of eight wasted hours for any investigation that involved antenna-structure data. Total FCC cost was calculated at approximately $500,000 per year. The staff also informally surveyed six engineering consulting firms, who estimated that their total expenditures for preparing multiple-application filings involving the same antenna structure exceeded $320,000 per year. Overall savings from the streamlining of tower registration processes could therefore approach $1 million dollars annually.

Root causes

The team considered 24 possible root causes for these inefficiencies. This number was reduced to the following six dominant issues:

1. Different coordination methods between the FCC bureaus in Washington, DC, and the Support Services Branch (SSB) in Gettysburg, PA;
2. The inefficient method for modifying FCC tower data and advising (multiple) licensees;
3. Different rules from bureau to bureau for accepting tower information changes;
4. Multiple applications due to any redefinition of coordinates or increase in tower height at multiple-use sites;
5. The difficulty or impossibility of accessing merge data from different FCC databases due to inconsistent tower data; and
6. The lack of uniform information in tower authorizations (e.g., coordinates, height and OML).

Eventually, one primary root cause was identified: Each bureau has a different method regarding coordination with the SSB in Gettysburg. For example, the team found that different forms, procedures and even different units of measure (e.g., meters vs. feet) are used. To address this, the team recommended that the agency adopt a commission-wide uniform procedure for authorizing changes in tower height, coordinates and OML involving existing antenna structures.

Multiple-use antenna structures

The FCC has determined that there is an average of 12 licensees per antenna structure. Currently, each of these licensees' authorization must be modified whenever the tower owner changes the height or OML.

The commission, however, is not consistent in how it processes these changes. Some licensees will automatically receive a modified authorization without submitting an application. Others will receive a notification indicating that their tower parameters have changed, and they must file an application to modify their authorization. Still others will receive nothing at all, but are nonetheless responsible for obtaining a modified license. This can result in individual licensees having different OML specifications on their respective autho-

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rizations for the same tower.

Instead of modifying each licensee's authorization, a better approach might be to make one party — the tower owner — responsible for tower information and OML. To understand the changes that this method would bring about, consider first the current process: The FAA requires notification prior to construction for all structures more than 200 feet above ground level (AGL) or if they intrude into airspace and pose a hazard to air navigation. These structures include tall buildings, water towers, silos and antenna towers.

After such notification, the FAA then conducts an air-hazard study or determination on the proposal and recommends steps, such as painting and lighting, to prevent airspace obstructions from threatening the safety of flight. Legally, the FAA determinations are non-binding recommendations.

Statutory authority has been given only to the FCC to enact and enforce regulations relating to antenna towers. The Communications Act directs the FCC to ensure that antenna towers are properly lighted and marked. The FCC relies heavily on the FAA's recommendations, however, and normally issues OML requirements to its licensees accordingly.

To understand the scale of the problem, consider the following statistics. There are approximately 500,000 antenna towers in the United States. Only 14% of these (70,000 towers) require obstruction marking and/or lighting. But, as stated previously, each of these towers holds an average of 12 licensees, so under present rules and procedures, some *850,000 licensees* are affected by OML requirements.

With all this in mind, the tower registration team proposed a solution, which was eventually incorporated into the current NPRM.

Recommendations

To provide standardized information on towers and tower owners, a unified, commission-wide process for antenna structure registration was proposed.

The FCC's Support Services Branch in Gettysburg will create a database of towers and owners that can be used as a cross-reference for all licensees on that tower. Each tower required to have OML will receive a unique registration number. This is in keeping with changes to Section 303(q) of the Communications Act, which makes tower owners responsible for tower painting and lighting. This new procedure will reduce the number of responsible parties from 850,000 licensees to 70,000 tower owners.

This means that tower owners will be primarily responsible for tower painting and lighting. They will have to perform the initial coordination with the FAA by filing FAA Form 7460-1. Once an FAA determination is received, the tower owners must then file a revised FCC Form 854 (Application for Antenna Structure Registration) with the FCC's Support Services Branch in Gettysburg. After the SSB clears the tower, it will issue FCC Form 854R (Antenna Structure Registration). This document will contain the unique antenna-structure registration number, which will be good for the life of the tower. The tower owner will be required to provide a copy of the Form 854R to all existing and prospective tenant licensees. Applicants needing FAA clearance for a new license on an existing tower will only have to refer to the tower's registration number when submitting an application.

This new process will reduce the number of filings and expedite routine clearances and minor change applications. For example, corrections to coordinates, changes in the tower height or changes to OML will not require that each licensee on the tower submit a license modification to incorporate the changes.

The new system will improve reliability and consistency of tower data. Numerous entries for the same tower lead to errors. Because the FCC will now collect information from only one source (the owner), there will be less

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likelihood of errors than the present system of collecting information from multiple sources.

Another advantage of the new process will be improved consistency of OML at multiple-use tower sites. FCC rules for changing antenna-structure information also will be consistent. The new process will enhance the commission's service to its broadcast customers by way of its "one-stop shopping" approach.

As a part of this changeover, the FCC also will provide access for the first time to a unified database open to all who wish to use it. Tower ownership information will be available to the public, FCC field inspectors and the FAA. For structures previously cleared, applications will not be delayed due to hold-ups in antenna-clearance procedures. But perhaps the biggest overall improvement will be the time and money saved by the commission and the industry at large.

The commission's proposal

In summary, the NPRM proposes to establish the following processes:

1. Create a whole new system for registering antenna structures;
2. Implement a single, commission-wide procedure;
3. Eliminate the filing of applications at multiple-use sites when the only change to the structure is height or OML;
4. Create a new tower database accessible to all commission staff, including Compliance and Information Bureau field offices, other government agencies (such as the FAA) and the public;
5. Adopt a revised FCC Form 854, titled "Application for Antenna Structure Registration," which all tower owners will be required to file;
6. Adopt and issue FCC Form 854R, titled "Antenna Structure Registration." This form will include a new "Notification of Antenna Structure Completion or Disposal," which will be mailed back to the FCC to keep the database accurate;
7. Revise and unify all bureaus' application forms regarding towers; and
8. Create a phase-in period for the new system.

Benefits

The enactment of this proposed regulation is expected to achieve the following results:

1. The FCC will save $500,000 per year, and private industry will save at least $321,000 per year;
2. There will be less delay when processing routine minor changes at the FCC, therefore, improving service to its customers; and
3. Coordination between the FCC's Support Services Branch in Gettysburg and the application processing branches in Washington, DC, will be streamlined.

The end result of this effort will prove that people with good ideas working together can make a difference. ■

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Photo courtesy of TowerCom, Ft. Lauderdale, FL.

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nel being more important than others.

Differential gain in an antenna was considered to be the difference in the gain at a particular frequency to that at the visual carrier. For older antennas, this value could be several decibels. This was primarily caused by differences in the vertical pattern across the band. Examples have been shown where the beam tilt is as much as 0.8° different between visual and aural carriers. For ATV, that would mean that the receive signal levels may vary several decibels between the upper and lower ends of the TV channel.

If the vertical beam shape is significantly different across the channel (meaning that the beam tilt changes with frequency), a new problem will result. When the antenna moves in the wind, the signal at the receiver will not change uniformly at all frequencies. Although AGC will attempt to control the signal levels, the result may well be an increase in the bit error rate (BER) in portions of the channel. The result at the further limits of the coverage area would be loss of the picture during one portion of the antenna sway with its return on a different portion of the sway. This can be controlled somewhat by proper tower design to maintain the antenna near vertical during tower movement. However, the differential gain and beam steering must be compensated for in the antenna design.

The NAB paper previously referenced demonstrates how reflections from adjacent structures impact the radiated pattern. In the example, the distance to the usable service contour varied by as much as 15 miles based on pattern distortions. It is noted that much of this variation can be compensated for by the equalizer at the receiver. However, while the equalizer can increase the gain at a given frequency or frequencies, the result is a decrease in the carrier-to-noise ratio (CNR). You can increase the gain but not without increasing the noise. This results in moving the system closer to the 15dB threshold increasing BER toward the failure point. At least this problem will be fairly constant, however. Although it will affect the distance to the coverage contour, it will not change from minute to minute.

The antenna system impedance also will have to be good across the entire band.

Designing a flameproof suit

The ATV antenna must have at least a 30dB return loss and the differential gain must be minimized. Reflections from adjacent structures also must be severely limited to obtain the desired coverage area. The return loss and gain must be handled in the antenna design, but should be checked by the user.

The matter of adjacent-structure pattern distortion can be predicted. The best way to do this is by modeling the antenna and mounting structure prior to construction. This allows the effects of the adjacent structure to be accurately determined. Various mounting configurations can be tried to find one that is optimum for the desired coverage area, as is often done for side-mounted FM antennas.

While significant, all of these factors can be handled and treated prior to the antenna construction. Remember, it's much easier to deal with a dragon on the ground than when it is breathing fire on top of your tower. ■

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Donald L. Markley owns D. L. Markley and Associates, a consulting engineering firm in Peoria, IL. Respond via the *BE* FAXback line at 913-967-1905 or via E-mail to be@intertec.com or by CompuServe at 74672,3124.

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Continued from page 56

ENG cameras available for less than $10,000 in our laboratory. (See Table 2.) For testing, a single fixed-focus (f/1.4) lens was used on all cameras with the shutter set at 1/60 second, gamma on and auto knee off. The calculated S/N in the table is simply based on the quoted camera S/N, the gain and whether there is pixel binning; no allowance has been made for possible noise-reduction techniques that may be implemented. Peak-to-peak noise was estimated from the WFM trace at five times gain. Note that only one camera of each type was tested, so results could differ between different cameras of the same model number.

The message is clear: be suspicious of claimed minimum illumination specifications as a predictor of low-light level performance of TV cameras unless camera gain, IRE out and S/N at the minimum illumination level are also specified. Low-end industrial cameras (1 CCD), if specified according to professional camera standards (70 to 100IRE out), will typically require five to 10 times their quoted minimum illumination specification, whereas consumer cameras may typically need 10 to 20 times their quoted minimum illuminations with considerably lower S/N in both cases.

For 3-CCD cameras, if the CCDs have on-chip lenslets to maximize use of incident light and associated electronic circuitry is carefully designed to give a good S/N specification of about 60dB, all professional and some high-end industrial cameras should have the same low-light level performance. This can vary if higher gain and/or an integration technique and/or digital noise reduction is implemented and is acceptable in the user's application. Values lower than about 7.5 lux at +18dB may indicate output less than 100IRE. Values of 4 lux at +24dB or 2 lux at +30dB will probably be associated with higher noise levels; values of about 2 lux probably involve pixel integration and/or digital noise reduction with some loss of spatial/temporal resolution. If 2/3-inch cameras are specified at f/1.4, can you find a lens at that f number or is f/1.7-f/1.8 the fastest lens available? Even if you understand exactly what is involved in the minimum illumination specification, do not count on the camera actually meeting specification.

If you are regularly involved in low-light level applications and are considering a camera purchase, before buying it is best to carefully test the camera under the conditions it will be used to see if it meets your expectations. ■

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MAINTENANCE ENGINEER Black Entertainment Television Inc. Ability to troubleshoot to the component level production switchers, digital video effects systems, routing switchers, vtr's character generators, cameras, editing systems and audio equipment. This will include system interfacing to computers and compatible components, equipment installation for studio and remote productions. Must be knowledgeable of system timing theory, broadcast specifications, and electronics course study. Ability to perform fiber switches and satellite downlink. Must have 3 years experience. BET, Corporate Human Resources, 1905-E 9th Street, N.E., Washington, D.C. 20018

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STUDIO SUPERVISOR. WPDE-TV 15, Florence/Myrtle Beach, SC , has an immediate opening for a studio supervisor with a minimum of five year experience in television studio operation and maintenance. 3215 South Cashua Drive, Florence, South Carolina 29501. (803) 665-1515.

TELEVISION MAINTENANCE ENGINEER- Northern Michigan network affiliate seeking enthusiastic individual, with strong background in computer systems, familiar with RF, audio and video repair. FCC general class license, or SBE equivalent, required. Must have ability to troubleshoot to component level. Send resume to: Broadcast Engineering, Dept. 762, Classified Ad Coordinator, 9800 Metcalf, Overland Park, KS 66212-2215.

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We're looking for very seasoned Engineers to work on designing large scale digital audio and video facilities. Candidates must be strong in system level engineering design, technical problem solving, team building and communications. Responsibilities will include the design of floor plans, equipment rack elevation layouts, and detailed signal flow construction diagrams. Fluency in Microsoft Excel for Windows is required; AutoCad, MS Word and MS Access software knowledge a plus.

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Contact Christine Young at (408) 955-4175 or send responses to: Sony Electronics Inc., 3300 Zanker Road, MS: SJ-2C2, San Jose, CA 95134; FAX (408) 955-5166. Or e-mail youngc@ccmail.nhq.sony.com. EOE

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2 **Which type of facility or operation best describes your primary business classification? (Please check only ONE box.)**

- 20 ❑ TV Station (including Networks & Low-Power TV)
- 26 ❑ Combination TV & Radio Station
- 39 ❑ Cable/Telco (including Networks)
- 28 ❑ Business TV (including Non-Broadcast TV)
- 29 ❑ Recording Studio
- 30 ❑ Teleproduction Facility/Independent Program Producer
- 40 ❑ Post-Production Facility
- 31 ❑ Microwave, Relay Station or Satellite Company for TV and Cable
- 32 ❑ Federal, State, Municipal Government
- 33 ❑ TV Consultant (Engineering or Management)
- 34 ❑ TV Dealer, Distributor or Manufacturer
- 41 ❑ Medical Facility
- 42 ❑ Law Enforcement/Training Facility
- 43 ❑ Military Broadcast or Video Production Facility
- 44 ❑ Defense Contractor
- 35 ❑ Other (please specify): _____

3 **Which of the following best describes your title? (Please check only ONE box.)**

A. Company Management:
- 01 ❑ Chairman of the Board
- 02 ❑ President
- 03 ❑ Owner
- 04 ❑ Partner
- 05 ❑ Director
- 06 ❑ Vice President
- 07 ❑ General Manager (other than in charge of Engineering or Station Operations)
- 08 ❑ Other Corporate/Financial Official

B. Technical Management & Engineering:
- 09 ❑ Technical Director/Manager
- 10 ❑ Chief Engineer
- 11 ❑ Other Engineering or Technical Title

C. Operations & Station Management/ Production & Programming:
- 12 ❑ Vice President Operations
- 13 ❑ Operations Manager/Director
- 14 ❑ Station Manager
- 15 ❑ Production Manager
- 16 ❑ Program Manager
- 17 ❑ News Director
- 18 ❑ Other Operations Title

D. Other (please specify): _____

4 **Which statement best describes your role in the purchase of equipment, components and accessories?**

- A ❑ Make **final decision** to buy specific makes, models, services or programs
- B ❑ **Specify** or **make recommendations** on makes, models, services or programs
- C ❑ Have **no part** in specifying or buying

Please continue on to Questions 5 and 6 below.

5 **Which of the following types of equipment will you be evaluating for purchase in the next 12 months? (Check ALL that apply.)**

1. Audio Products
- 1A ❑ Audio consoles
- 1B ❑ Digital audio workstations
- 1C ❑ Distribution amplifiers
- 1D ❑ Headphones, headsets, intercoms
- 1E ❑ ISDN telephone interface
- 1F ❑ Magnetic tape, audio
- 1G ❑ Microphones
- 1H ❑ Mixers
- 1I ❑ Monitors (speakers)
- 1J ❑ Recorders, players
- 1K ❑ Switchers, routing

2. Video Products
- 2A ❑ Camera heads, tripods, pedestals, booms, dollies
- 2B ❑ Cameras; lenses
- 2C ❑ Graphics, titling systems
- 2D ❑ Desktop editing systems
- 2E ❑ Digital effects, paint, animation systems
- 2F ❑ Editing controllers, systems
- 2G ❑ Frame synchronizers, time base correctors
- 2H ❑ Lighting systems
- 2I ❑ Magnetic tape, video
- 2J ❑ Monitors (picture, studio quality)
- 2K ❑ Recorders, players
- 2L ❑ Robotic camera controls
- 2M ❑ Signal processing
- 2N ❑ Signal routing, distribution
- 2O ❑ Standards, format & scan converters
- 2P ❑ Still store systems
- 2Q ❑ Switchers, production
- 2R ❑ Video servers
- 2S ❑ HDTV Equipment

3. Test & Measurement Products
- 3A ❑ Analyzers, audio, video, RF
- 3B ❑ Audio, video signal generators
- 3C ❑ Waveform, vectorscope monitors
- 3D ❑ Digital signal testing

4. Miscellaneous Products
- 4A ❑ Battery packs, chargers
- 4B ❑ Cabinets, racks, consoles
- 4C ❑ Cables, connectors
- 4D ❑ Carts, cases (equipment, shipping), tools

5. RF Products
- 5A ❑ ENG components
- 5B ❑ Exciters
- 5C ❑ Fiber optics
- 5D ❑ Modulators
- 5E ❑ Power amplifiers, cavities
- 5F ❑ Receivers
- 5G ❑ Remote production vehicles, program relays
- 5H ❑ Satellite T/R components, electronics
- 5I ❑ STL components, electronics
- 5J ❑ Switches, RF coaxial
- 5K ❑ Transmitters
- 5L ❑ Antenna systems, towers
- 5M ❑ Transmitter, remote controls
- 5N ❑ Tubes
- 5O ❑ Weather, radar RF products

6. Automation & Computer Products
- 6A ❑ Accessories/peripherals, Macintosh
- 6B ❑ Accessories/peripherals, Amiga
- 6C ❑ Accessories/peripherals, PC
- 6D ❑ Accessories/peripherals, SGI
- 6E ❑ Automation systems
- 6F ❑ Cards, NTSC graphics interface
- 6G ❑ Cards, time base corrector
- 6H ❑ Business automation
- 6I ❑ Commercial insertion systems
- 6J ❑ Cards, technical monitoring
- 6K ❑ Machine control
- 6L ❑ Newsroom automation
- 6M ❑ Platforms, Macintosh
- 6N ❑ Platforms, PC
- 6O ❑ Platforms, SGI
- 6P ❑ Record/playback automation
- 6Q ❑ Software, engineering
- 6R ❑ Software, production, planning
- 6S ❑ Software, videographics

7. ❑ **None of the Above**

6 **What is the budget for equipment you are evaluating for purchase in the next 12 months?**

- 1 ❑ Less than $10,000
- 2 ❑ $10,000 - $24,999
- 3 ❑ $25,000 - $49,999
- 4 ❑ $50,000 - $99,999
- 5 ❑ $100,000 - $299,999
- 6 ❑ $300,000 - $499,999
- 7 ❑ $500,000 and up

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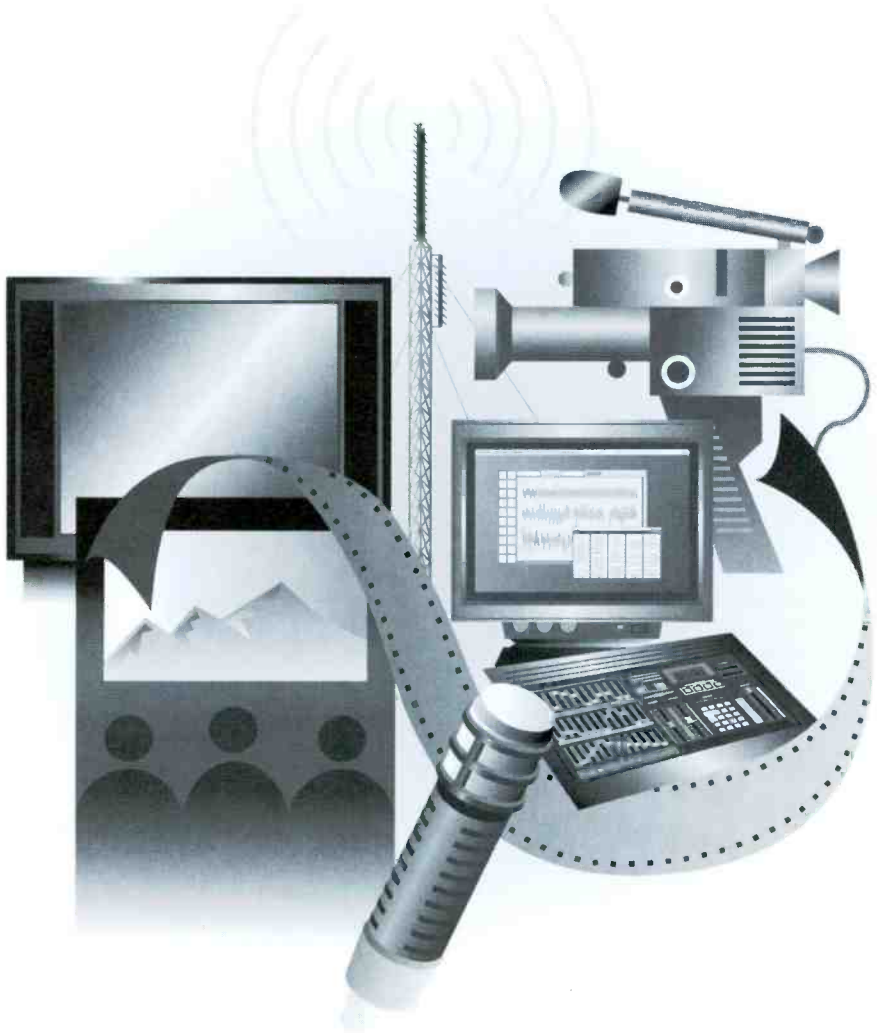

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